SOILS REPORT No. 8 1958

REPORT OF

RECONNAISSANCE SOIL SURVEY

OF

WEST-LAKE MAP SHEET AREA

By

W. A. EHRLICH, L. E. PRATT,

E. A. POYSER AND F. P. LECLAIRE

With a Soil Map covering Townships 15 to 22 Ranges 8 to 18 (inclusive) West of the Principal Meridian, prepared by the Manitoba Soil Survey.

MANITOBA SOIL SURVEY

CANADA DEPARTMENT *of* AGRICULTURE,
MANITOBA DEPARTMENT *of* AGRICULTURE AND IMMIGRATION,
AND SOILS DEPARTMENT, THE UNIVERSITY *of* MANITOBA

Report published by the Manitoba Department of Agriculture and Immigration.
Map published by Canada Department of Agriculture.

Glenn A. Kreutzer

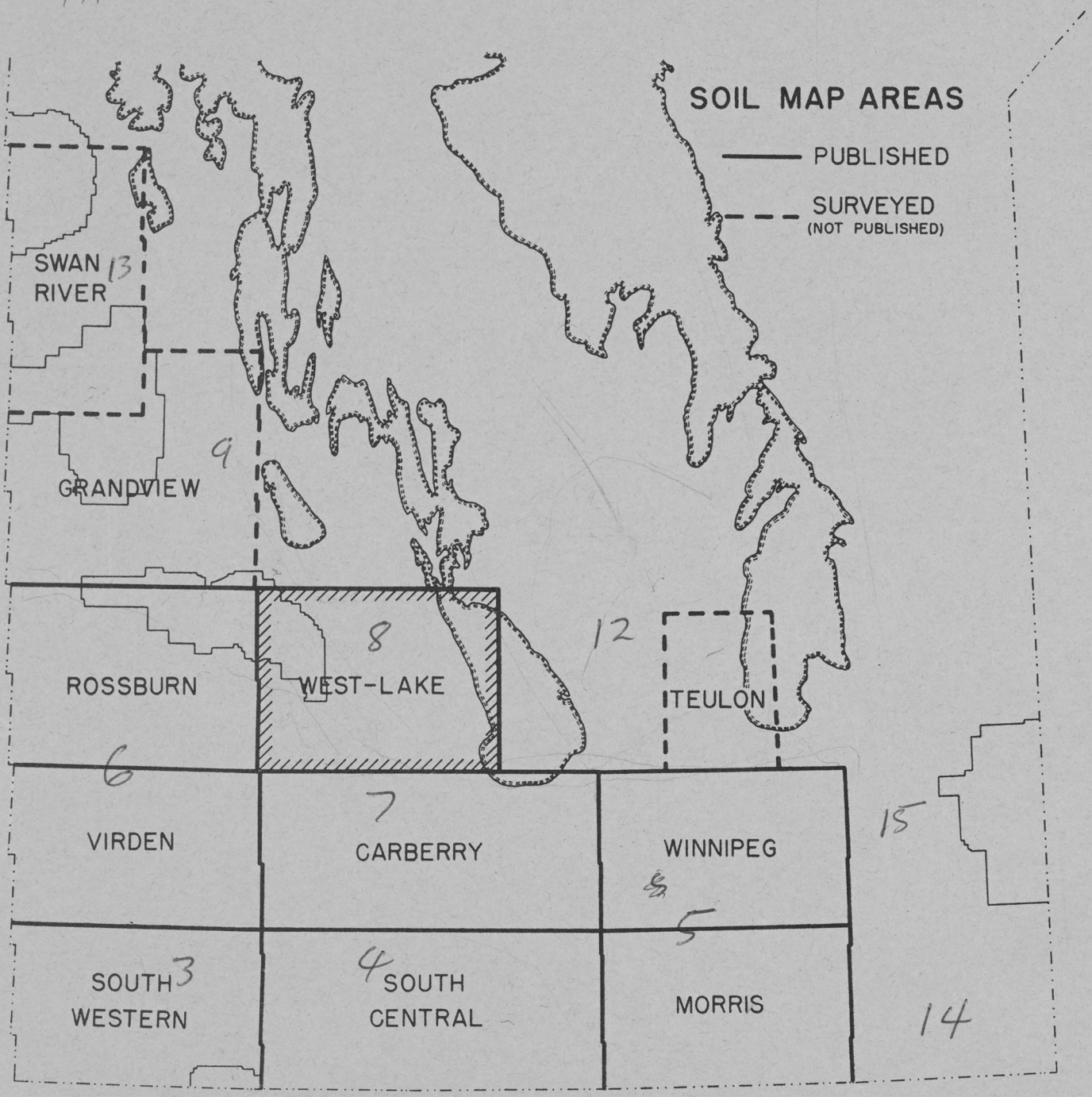

FIGURE 1

REPORT OF

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Acknowledgments

THE SOIL SURVEY of the West-Lake Map Sheet Area was conducted as a joint project by the Canada Department of Agriculture, the Manitoba Department of Agriculture, and the Soils Department of The University of Manitoba.

Acknowledgment is made to Dr. P. C. Stobbe, Mr. J. H. Day, Canada Department of Agriculture and Dr. R. A. Hedlin, Department of Soils, The University of Manitoba, for their critical review of the report.

The soils were mapped in the field by W. A. Ehrlich, L. E. Pratt, E. A. Poyser, F. P. Leclaire, R. E. Smith, R. A. Wallace, J. A. Robertson and G. Emmond. Mrs. Helen E. Gallagher assisted in the recording of field and laboratory data and in the preparation of the report.

The final drafting and printing of the soil map was undertaken and financed by the Experimental Farms Service, Canada Department of Agriculture, Ottawa, and the printing of the report was undertaken and financed by the Manitoba Department of Agriculture and Immigration.

Summary

THE RECONNAISSANCE SOIL SURVEY of the West-Lake Map Sheet Area covers 2,316 square miles in the central portion of Southern Manitoba between Lake Manitoba and the Riding Mountain National Park. The West-Lake map area is divided into two broad physiographic areas by the Manitoba escarpment. Above the escarpment, the topography is irregular, gently to steeply sloping and the soils are dominantly well-drained, whereas below the escarpment the topography is nearly level and the soils are dominantly imperfectly drained. The climate of the area is sub-humid and has a definite summer maximum of precipitation. Frost is a hazard to grain production in the Dark Grey and Grey Wooded soil areas, occurring on the southern slopes of the Riding Mountain. Vegetation tends to vary with latitude and altitude. Below the escarpment, the aspen-oak type of native vegetation covers all of the lowlands, except a portion in the north-east corner where jack pine and tamarack are present. Above the escarpment, the aspen-oak type of vegetation prevails in the southern area and mixed woods occur on the higher land in the northern portion.

The soils above the escarpment are dominantly well-drained members of the Black, Dark Grey Wooded and Grey Wooded types, whereas the soils below the escarpment are dominantly imperfectly drained members of the above-mentioned types. Productivity of these soils varies with texture, topography, drainage and degree of degradation. Approximately 37 per cent of the farm land is under cultivation. Grain growing is the principal farm enterprise and over 90 per cent of the cultivated land is utilized for grain and flaxseed production. Generally, wheat is the principal crop grown on the Black soils and coarse grains are the main crops on the other soils. The general cropping practice is one year fallow followed by two years of grain. Livestock are produced on most farms; in some areas with a low arable-land acreage livestock production is the major farm enterprise.

Introduction

THE RECONNAISSANCE SOIL SURVEY of the West-Lake Map Sheet Area is the eighth of a series of reports devoted to the description of the soils of Manitoba as determined through the work of the Manitoba Soil Survey. The object of the survey was to obtain the essential facts about the soils of the area. The publication consists of two parts, a colored soil map and a report.

The West-Lake soil map indicates the distribution and area of the soil associations. The soil map was drafted at the scale of one inch equals two miles. Township and Range numbers are shown along the margin of the map. Solid black boundary lines are used to separate associations and phases of associations, and broken black boundary lines are used to separate associates within the associations. Soil associations and phases are identified by color and letter designation. Local soil conditions such as poor drainage, salinity, stoniness, and rough topography are indicated by defined symbols. A key to the colors, letter designations and symbols appears at the bottom of the map.

The report describes the cultural and physical features of the map area and the formation, character, capabilities and limitations of the soils. The report is divided into four parts. Part I describes the location and extent of the area, the population distribution and the transportation and market facilities. Part II describes the physical features including relief, drainage, geology, climate and vegetation. Part III presents a key to the soils of the area, describes the physical, morphological and agronomic features of each association, presents a grouping of the soils into eight land-use classes and a table indicating the adaptability of each soil to regional crops. Part IV outlines the history of early settlement and describes land use.

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REPORT OF THE RECONNAISSANCE SOIL SURVEY
of the
WEST-LAKE MAP SHEET AREA

Part I.
GENERAL DESCRIPTION OF AREA

A. LOCATION AND EXTENT

The West-Lake map area lies in the central portion of southern Manitoba between Lake Manitoba and the Riding Mountain National Park. The location of this area with respect to other soil map areas is shown in Figure 1. The West-Lake map includes Townships 15 to 22 in Ranges 8 to 18, and covers approximately 1,482,100 acres exclusive of the Riding Mountain National Park, Lake Manitoba, and a small land area lying on the east side of Lake Manitoba. The map area covers the muni-

MUNICIPALITIES IN THE WEST-LAKE MAP AREA

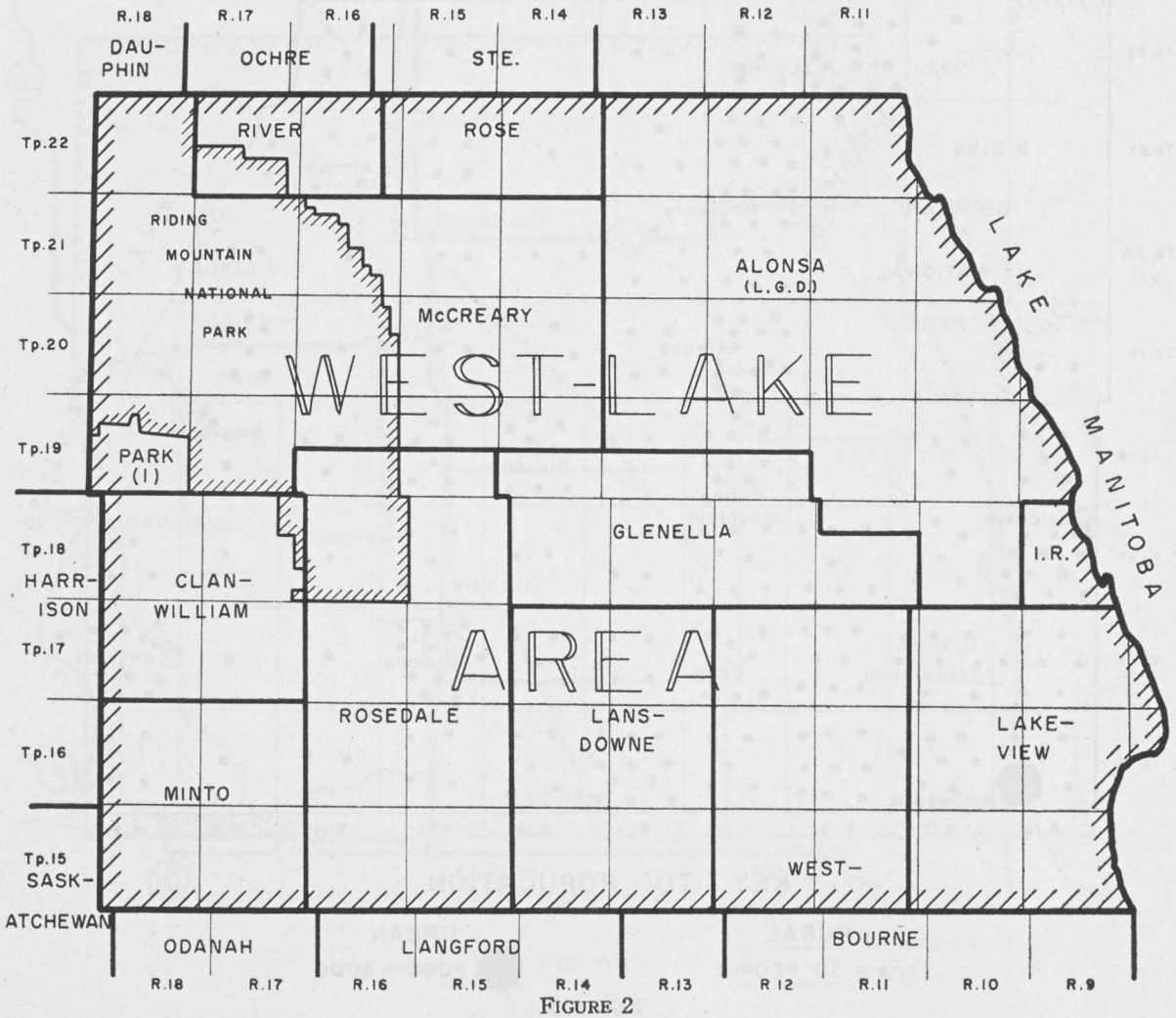


FIGURE 2

cipalities of Lakeview, Glenella, Rosedale, Clanwilliam, Minto, McCreary, and portions of the municipalities of Lansdowne, Westbourne, Sainte Rose du Lac, and Ochre River. In addition it includes the Sandy Bay Indian Reserve and portions of the Local Government Districts of Alonsa and Park I (See Figure 2.)

B. POPULATION

According to the 1951 census the total population of the West-Lake map area was 18,377. This represents a population density of about 8 people per square mile. Approximately 11 per cent (2,085) of these people live in the incorporated town of Minnedosa and about 89 percent (16,292) live on farms and in unincorporated towns and villages. The distribution of this rural population is shown in Figure 3. The average density of rural population is 7 people per square mile. The population is concentrated in areas with a large percentage of arable soils and in towns on the principal transportation and communication arteries.

THE DISTRIBUTION OF POPULATION IN WEST-LAKE MAP AREA

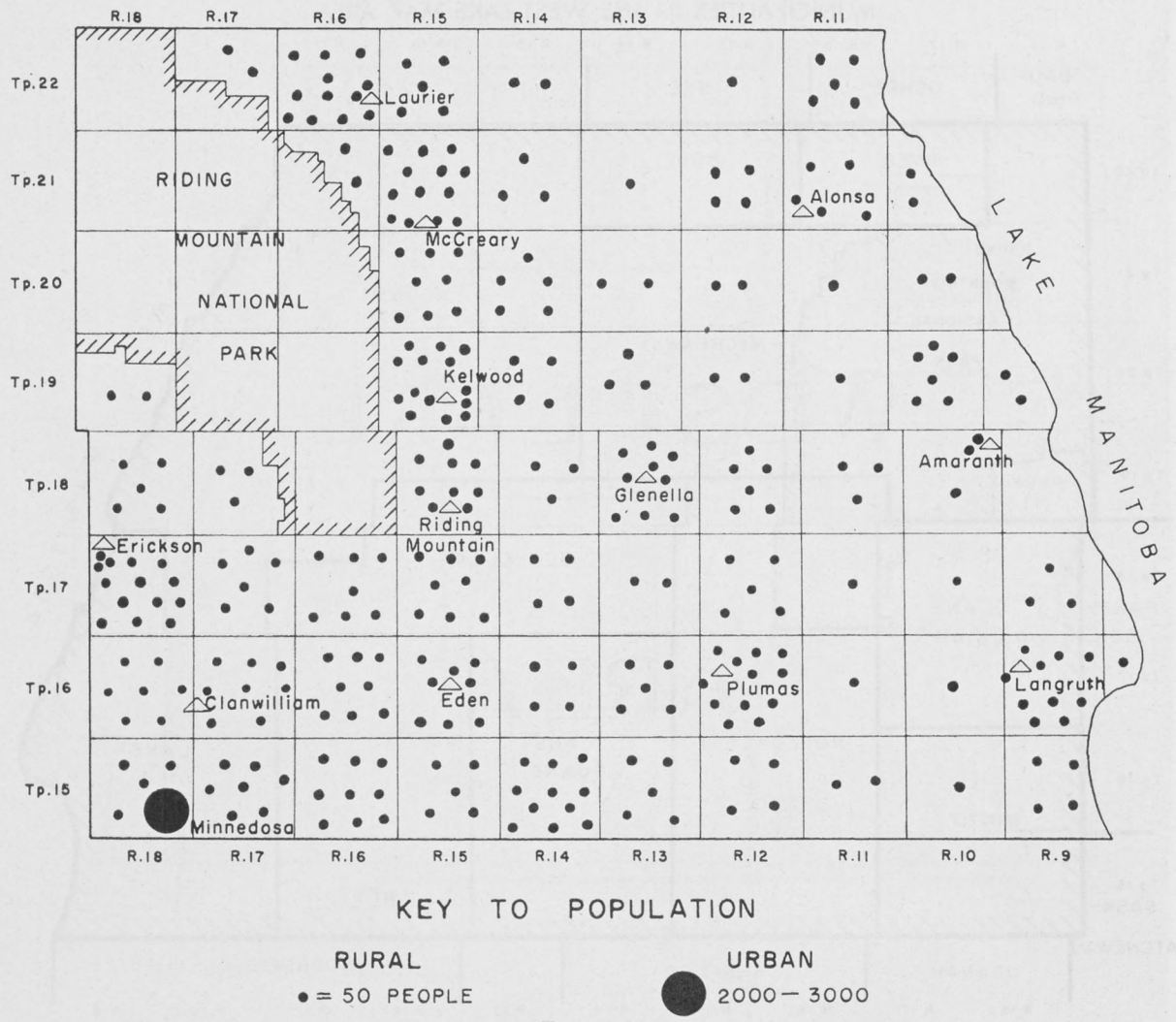


FIGURE 3

C. TRANSPORTATION AND MARKETS

The railroads and highways that traverse the West-Lake map area provide a fairly adequate transportation and communication network between the principal towns and villages (Figure 4). A network of market roads serve the local farm communities. Most of these roads have been constructed along the road allowances bordering each section of land, but some have been constructed along the gravel beach ridges common to the area. Most of the market roads are of the graded earthen type but some have been gravelled. Roads are numerous in highly productive farm areas whereas only a few have been constructed in areas with a large percentage of non-arable land.

Most of the agricultural produce is transported to markets outside of the map area. Local towns and villages provide a very small market for dairy and vegetable products, and local dairies provide processing facilities for some produce. The principal marketing and processing facilities are located at Winnipeg one hundred miles east of the map area.

RAILROADS AND HIGHWAYS IN THE WEST-LAKE MAP AREA

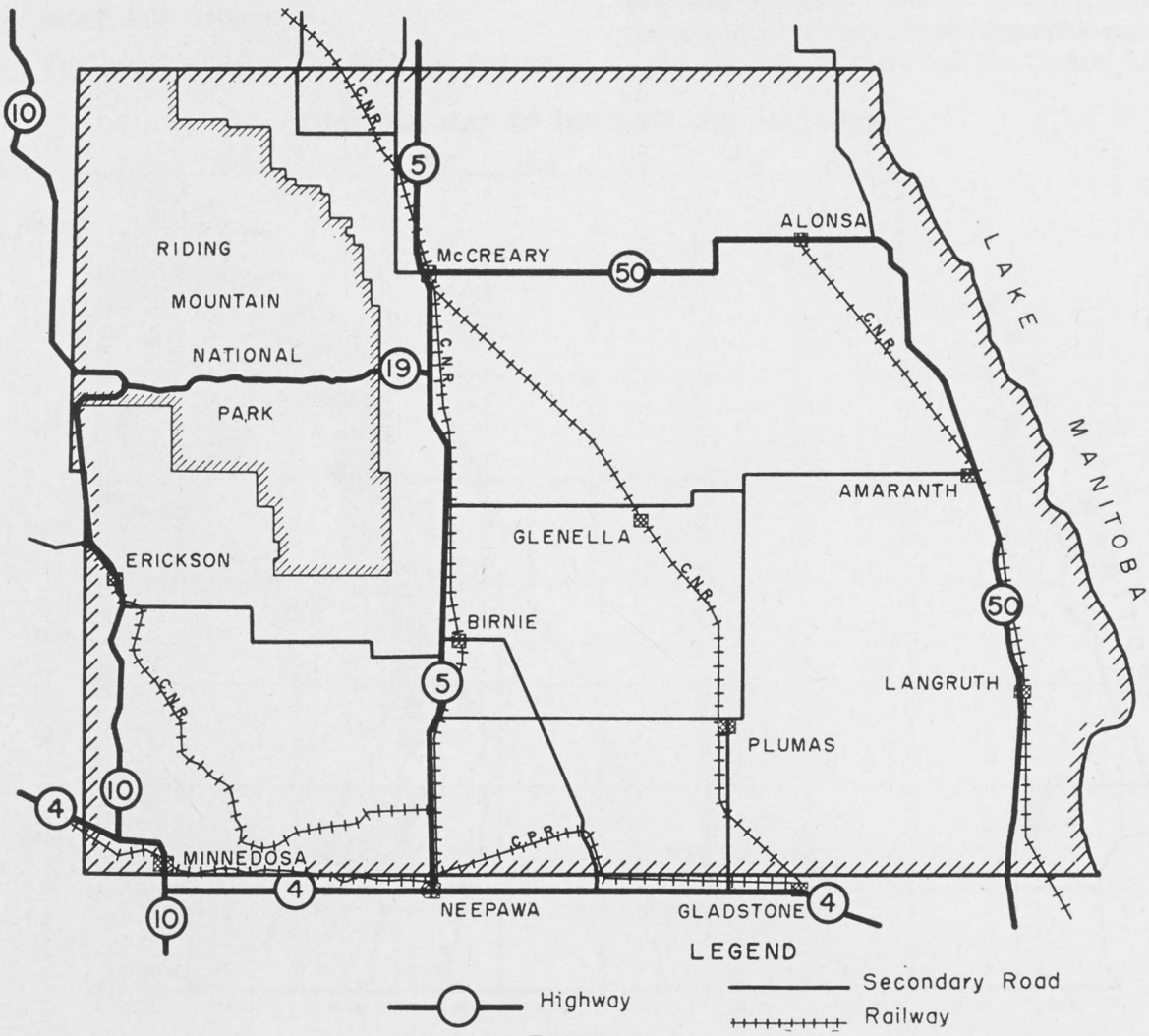


FIGURE 4

Part II.

PHYSIOGRAPHIC FACTORS AFFECTING SOIL FORMATION

The principal factors affecting soil formation are climate, vegetation, parent material, relief and drainage. The type of soil formed at any one place is dependent upon the interaction of these factors, the length of time they have been operative and the modifications resulting from the work of man.

A. RELIEF AND DRAINAGE

The principal relief and drainage features of the West-Lake map area are shown in Figures 5 and 6.

The elevation of the West-Lake map area ranges from a maximum of 2200 feet (A.S.L.) in the Riding Mountain National Park to 814 feet (A.S.L.), the mean elevation of Lake Manitoba. The Manitoba Escarpment, rising from approximately 1200 feet (A.S.L.), divides the map area between two physiographic regions —the Western Uplands and the Central Low-

CONTOUR MAP OF THE WEST-LAKE MAP AREA

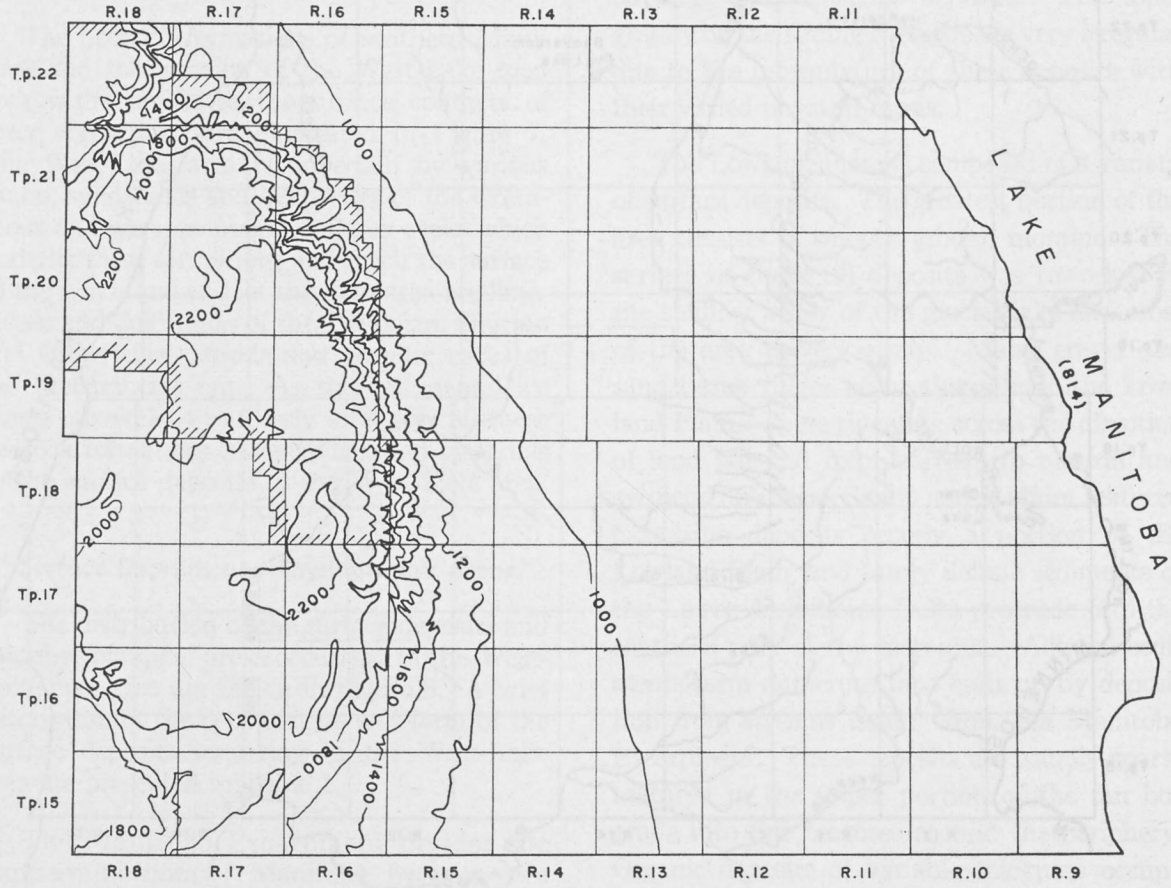


FIGURE 5

lands of Manitoba. In the northern and central portions of the map sheet, the escarpment forms an abrupt rise of 800 to 1000 feet within three to five miles. In the southern portion the slope is more gentle and the land rises 600 to 800 feet in seven to ten miles. The steeper part of the escarpment is deeply incised by numerous ravines cut through the surface deposits and into the shale bedrock. Above the escarpment the land forms a morainic till plain dotted by many small lakes and shale hillocks. Below the escarpment, the smooth lacustrine and till plain slopes gently down to the west shore of Lake Manitoba. The near level topography is broken only by low beach ridges and gentle undulations in the boulder till surface.

Surface drainage of different parts of the West-Lake map area is very divergent. The north-western part is drained by the Ochre and Turtle river systems flowing into Lake Dauphin; the south-western part lies in the watershed of the Minnedosa River, a tributary of the Assiniboine River; the south-central portion is drained by the Whitemud River system into Lake Manitoba; while the entire eastern half of the map area is lacking adequate natural drainage and most of the runoff waters collect in local sloughs and swamps. The drainage in portions of this lowland area has been improved by construction of drainage ditches leading into Lake Manitoba. However much of this land is still subject to flooding in wet seasons.

DRAINAGE SYSTEM OF THE WEST-LAKE MAP AREA

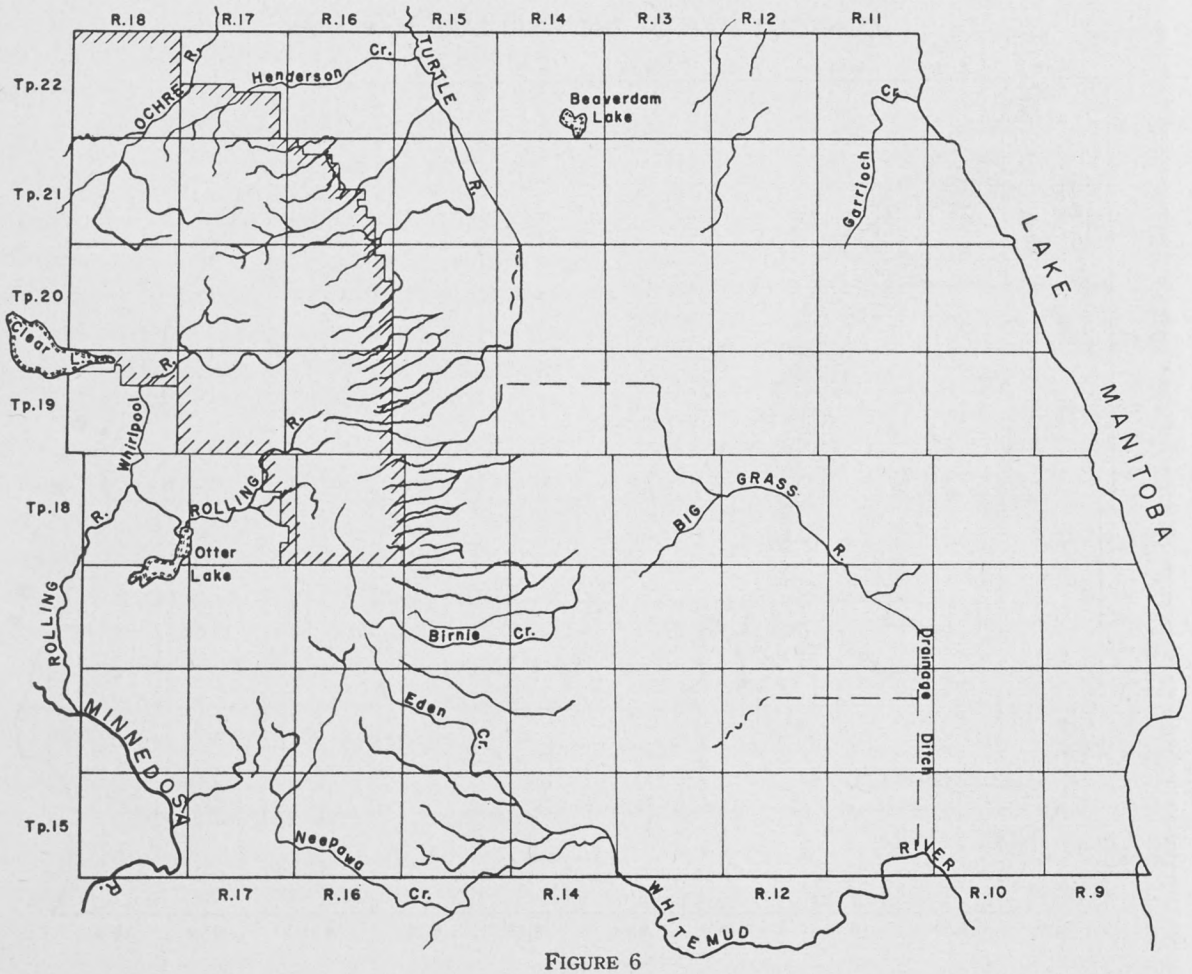


FIGURE 6

B. GEOLOGY AND SOIL PARENT MATERIALS

A surface mantle of unconsolidated rock materials cover the bedrock formations throughout the West-Lake map area. These unconsolidated materials are composed of rock fragments derived from bedrock formations through the action of continental ice sheets which completely covered Manitoba in recent geological times. The ice sheets picked up and transported huge quantities of materials from the bedrock formations over which they passed. When the ice sheets melted the rock materials were deposited as glacial drift in various forms. These drift deposits, along with small areas of recent alluvium, constitute the parent materials from which the soils have been developed.

(i) Geology of the Underlying Rocks

The bedrock formations of southern Manitoba and the location of the West-Lake map area with respect to the surface contacts of these formations are illustrated in Figure 7. The West-Lake area is underlain by various shales, sandstones and evaporites of the Cretaceous and Jurassic periods. Other rocks which underlie these formations and reach the surface to the north and east of the map area are limestones and dolostones of the Devonian, Silurian and Ordovician periods and granitic rocks of the Precambrian era. As the continental ice sheets moved in a southerly direction, all these bedrock formations have contributed materials to the surface deposits of the West-Lake area.

(ii) Surface Deposits and Physiographic Areas

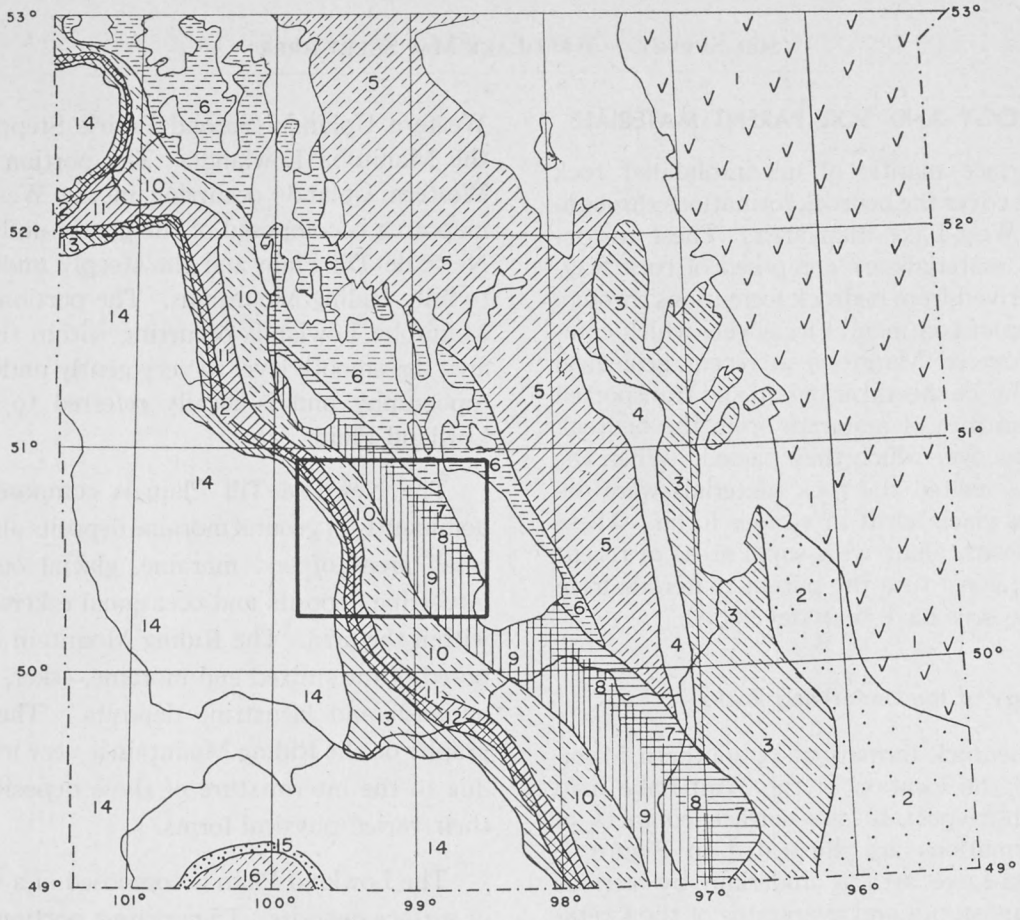
The distribution of the surface deposits and the physiographic areas occurring in the West-Lake map area are shown in Figure 8. A brief description of the constitution and form of the surface deposits occurring in the West-Lake area are presented in Table 1.

The Manitoba Escarpment divides the southern portion of Manitoba between two broad physiographic regions known as the Western Uplands (Second Prairie Steppe) and the Manitoba Lowlands. The portion of the Western Uplands occurring in the West-Lake map area is composed of the gently undulating Newdale Till Plain and the steeply undulating to hilly Riding Mountains. The portion of the Manitoba Lowlands occurring within the map area has smooth level to very gently undulating topography and is locally referred to as the Lowland Plain.

The Newdale Till Plain is composed predominantly of ground moraine deposits although small areas of end moraine, glacial outwash, lacustrine deposits and occasional eskers, occur within the area. The Riding Mountain is composed of intermixed end moraine, esker, glacial outwash and lacustrine deposits. The topography on the Riding Mountain is very irregular due to the intermixture of these deposits with their varied physical forms.

The Lowland Plain is composed of a variety of surface deposits. The greatest portion of the area consists of smooth ground moraine. The surface of these till deposits was reworked in the shallow water of the glacial lake and most of the area is very stony. Many gravel and sand beach ridges occur throughout the Lowland Plain. These ridges lie across the direction of land fall and form barriers to natural and artificial drainage. Sandy and medium textured lacustrine deposits occupy a portion of the Lowland Plain, and sandy deltaic sediments of the Lower Assiniboine Delta protrude into the southern part of the map area. Alluvial sediments form numerous fans built up by deposition from streams issuing from the Manitoba Escarpment. These deposits are usually coarse textured in the upper portion of the fan but grade into fine textures around the periphery. Organic deposits of variable thickness occupy the depressional areas in the Lowland Plain.

BEDROCK FORMATION IN SOUTHERN MANITOBA



KEY TO ROCK FORMATIONS

CENOZOIC

TERTIARY

16 — TURTLE MTN. FORMATION: Mottled shales and lignite beds

MESOZOIC

CRETACEOUS OR TERTIARY

15 — BOISSEVAIN FORMATION: Sandstone

UPPER CRETACEOUS

14 — RIDING MTN. FORMATION: Light grey hard shale and soft greenish shale

13 — VERMILION RIVER FORMATION: Acid and calcareous shales, some bentonite

12 — FAVEL FORMATION: Grey shale, some limestone and bentonite.

LOWER AND UPPER CRETACEOUS

11 — ASHVILLE FORMATION: Dark grey shale with lime and sandy beds

LOWER CRETACEOUS AND EARLIER

10 — SWAN RIVER GROUP: Sandstone, shale and low grade coal

JURASSIC AND EARLIER

9 — SUNDANCE FORMATION: Glauconitic sandstone, shale, limestone and gypsum

8 — GYPSUM SPRINGS FORMATION: Red shale and gypsum

7 — SPEARFISH FORMATION: Red to brown shales and red argillaceous sandstone

PALAEOZOIC

DEVONIAN

6 — UNNAMED DEVONIAN: Limestone and dolostone

SILURIAN

5 — INTERLAKE GROUP: Dolostone

ORDOVICIAN

4 — STONY MTN. FORMATION: Limestone and dolostone, red shale

3 — RED RIVER FORMATION: Limestone and dolostone

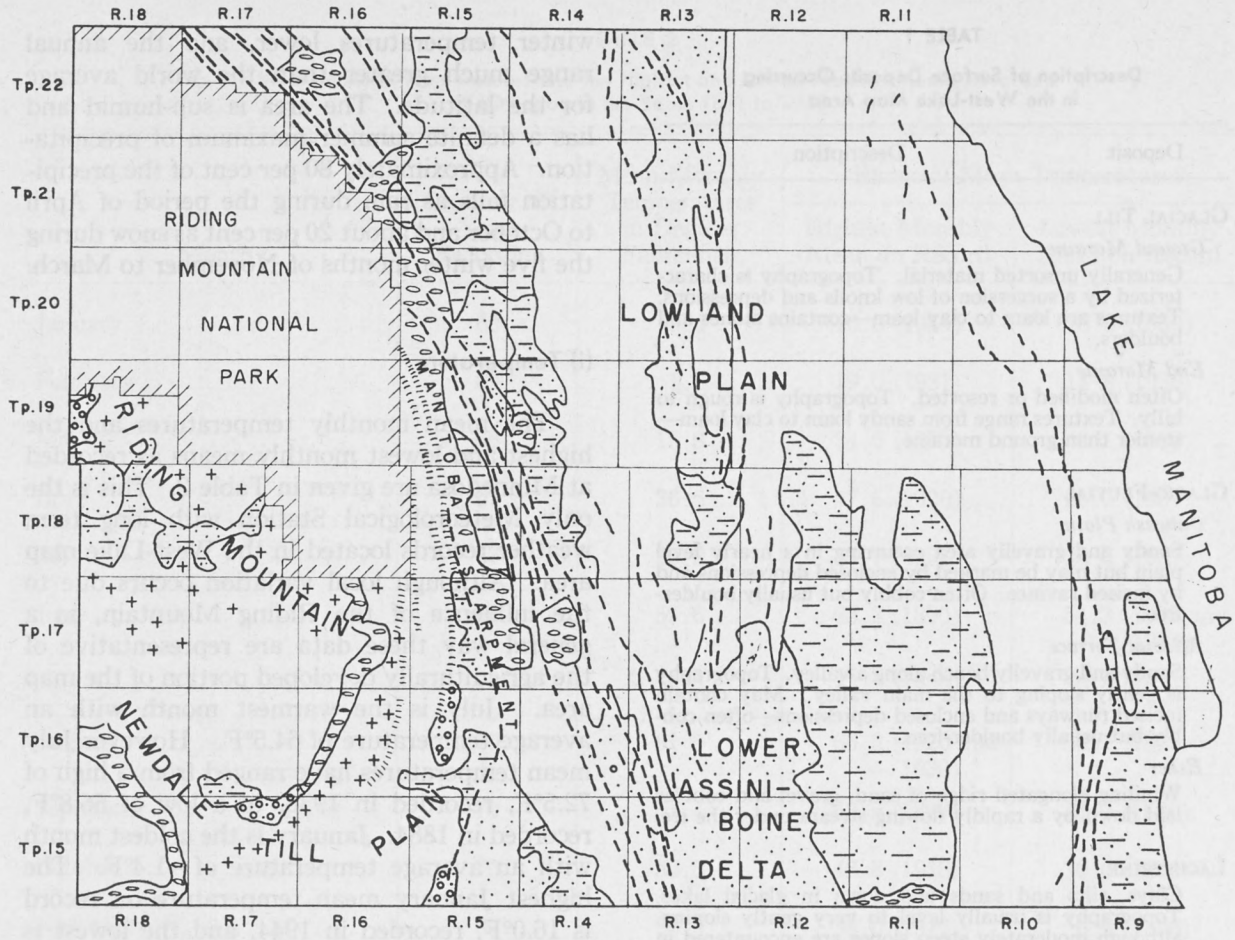
2 — WINNIPEG FORMATION: Sandstone, minor shale

ARCHEAN OR PROTEROZOIC

Chiefly acidic intrusive rocks

FIGURE 7

SURFACE DEPOSITS AND PHYSIOGRAPHIC AREAS IN THE WEST-LAKE MAP AREA



LEGEND

GLACIAL TILL DEPOSITS

GROUND MORAINE

END MORAINE

GLACIO-FLUVIAL DEPOSITS

OUTWASH PLAIN

ALLUVIAL DEPOSITS

RECENT ALLUVIUM AND ALLUVIAL TERRACE

LACUSTRINE DEPOSITS

COARSE TEXTURED

MEDIUM TEXTURED

FINE TEXTURED

BEACHES AND BARS

SHARP ESCARPMENT

FIGURE 8

TABLE 1

Description of Surface Deposits Occurring in the West-Lake Map Area

Deposit	Description
GLACIAL TILL	
Ground Moraine	Generally unsorted material. Topography is characterized by a succession of low knolls and depressions. Textures are loam to clay loam—contains stones and boulders.
End Moraine	Often modified or resorted. Topography is rough to hilly. Textures range from sandy loam to clay loam—stonier than ground moraine.
GLACIO-FLUVIAL	
Outwash Plain	Sandy and gravelly area occurring in a nearly level plain but may be marked by enclosed depressions and by incised ravines. Often cobbly but usually boulder-free.
Alluvial Terrace	Sandy and gravelly bench along a valley. Topography is gently sloping to the main valley. May contain incised runways and enclosed depressions—often cobbly but usually boulder-free.
Esker	Winding elongated ridge of sand, gravel and cobbles laid down by a rapidly flowing stream under the ice.
LACUSTRINE	Clays, silts and sands laid down in glacial lakes. Topography is usually level to very gently sloping, although moderately steep slopes are encountered in some areas. Usually free of stones but some stones occur where thin lacustral deposits are underlain with till.
RECENT ALLUVIAL	Post-glacial deposits of sands, silts and clays. Usually found along streams. Also includes mucks and peats. Soils are immature. Topography is nearly level. Usually free of stones.

C. CLIMATE

In relation to world-wide climatic conditions, the West-Lake map area of Manitoba is within the region designated by Köppen as Dfb.* This is an area which lies in the centre of the continent, a great distance from the oceans and their modifying effect on temperatures. Summer temperatures are higher, winter temperatures lower, and the annual range much greater than the world average for the latitude. The area is sub-humid and has a definite summer maximum of precipitation. Approximately 80 per cent of the precipitation falls as rain during the period of April to October and about 20 per cent as snow during the five winter months of November to March.

(i) Temperature

The mean monthly temperatures and the highest and lowest monthly means as recorded at Minnedosa are given in Table 2. This is the only Meteorological Station with long term weather records located in the West-Lake map area. Although local variation occurs due to the influence of the Riding Mountain, in a general way these data are representative of the agriculturally developed portion of the map area. July is the warmest month with an average temperature of 64.5°F. However July mean temperatures have ranged from a high of 72.5°F, recorded in 1936, to a low of 56.8°F, recorded in 1884. January is the coldest month with an average temperature of –1.4°F. The highest January mean temperature on record is 16.0°F, recorded in 1944, and the lowest is –18.8°F, recorded in 1950.

Two commonly recognized values that indicate the length of the growing season are the frost-free period and the vegetative season.* In the West-Lake map area the frost-free period ranges from 90 to 100 days and the vegetative season is within the range of 170-180 days.**

(ii) Precipitation

The mean monthly precipitation and the highest and lowest monthly totals as recorded at Minnedosa are given in Table 3. June is the

*W. Köppen and Geiger, "Handbuch der Klimatologie", Bond I, Teil C, Gebuder Borntraeger, Berlin, 1936.

*Frost-free period is the length of time between average dates of the last frost in spring and the first frost in autumn. Vegetative season is the average length of time during the summer months when the daily temperature is above 42°F.

**B. W. Currie. "Vegetative and Frost-free Seasons, Prairie Provinces and Northwest Territories", Physics Department, University of Saskatchewan, 1954.

TABLE 2

The Mean Monthly Temperatures and the Highest and Lowest Monthly Means Recorded at Minnedoa in the Years 1881 to 1951

Month	Number of Years Recording	Mean Monthly Temperatures in Degrees Fahrenheit	Range of Mean Temperatures	
			Highest Monthly Mean on Record	Lowest Monthly Mean on Record
January	69	-1.4	16.0 (1944)	-18.8 (1950)
February	69	1.8	19.0 (1931)	-14.8 (1936)
March	68	15.8	34.5 (1910)	0.1 (1899)
April	67	36.6	47.6 (1900)	25.6 (1907)
May	67	50.2	57.7 (1901)	38.6 (1907)
June	68	59.6	65.2 (1890)	54.3 (1902 and 1915)
July	70	64.5	72.5 (1936)	56.8 (1884)
August	70	61.5	66.0 (1920 and 1930)	54.1 (1885)
September	70	51.4	60.5 (1897)	44.7 (1886)
October	70	39.3	47.8 (1918)	30.0 (1919)
November	69	20.9	35.0 (1917)	6.6 (1896)
December	69	6.8	22.2 (1939)	-7.0 (1917 and 1927)
		Yearly Mean 33.9	Highest Yearly Mean 39.3 (1931)	Lowest Yearly Mean 27.0 (1883)

wettest month with an average precipitation of 3.11 inches. However rainfall during June has ranged from a high of 7.85 inches, recorded in 1881, to a low of 0.31 inches, recorded in 1912. December is the driest month with an average precipitation of 0.62 inches. The highest December precipitation on record is 1.85 inches, recorded in 1883, while only 0.05 inches was recorded in December of 1931. The yearly mean precipitation at Minnedosa is 17.39 inches. During the 68 years in which complete records have been kept there has been 16 years in which the precipitation was between 9 and 15 inches, 40 years in which the precipitation was between 15 and 20 inches, and 12 years in which the precipitation was between 20 and 26 inches.

On the average 13.6 inches of precipitation falls as rain during the summer months of April to October, and 3.8 inches of precipitation is received during the winter months of November to March, mainly in the form of snow.

TABLE 3

The Mean Monthly Precipitation and the Highest and Lowest Monthly Totals Recorded at Minnedosa in the Years 1881 to 1951

Month	Number of Years Recorded	Mean Monthly Precipitation in Inches	Monthly Precipitation Range in Different Years	
			Highest Monthly Precipitation	Lowest Monthly Precipitation
January	70	.77	2.22 (1917)	.00 (1944)
February	70	.66	3.66 (1938)	.03 (1928)
March	69	.84	2.58 (1902)	.09 (1939)
April	69	1.11	6.92 (1924)	.01 (1940)
May	69	1.89	5.43 (1927)	.04 (1917)
June	69	3.11	7.85 (1881)	.31 (1912)
July	70	2.61	6.00 (1933)	.51 (1936)
August	70	2.13	5.42 (1911)	.27 (1929)
September	70	1.63	4.64 (1881)	.04 (1948)
October	70	1.15	5.25 (1882)	.15 (1895)
November	69	.87	2.79 (1922)	.03 (1939)
December	69	.62	1.85 (1883)	.05 (1931)
		Yearly Mean 17.39	Highest 12 Months November to October 25.33 (1934-35)	Lowest 12 Months November to October 9.81 (1928-29)

(iii) Local Variation in Climate

General observations indicate some important local variations in climate within the West-Lake map area. Unfortunately there is very little recorded meteorological data to give numerical expression of these variations. Short term records at Neepawa indicate that the climate is slightly warmer in the Lowland region than it is at Minnedosa, which is situated at approximately 1800 feet a.s.l. This is substantiated by records at Dauphin, located 15 miles north of the map sheet at 950 feet a.s.l. During the same 40 year period, the mean temperature was 2°F higher at Dauphin than it was at Minnedosa. These temperature differences reflect the effect of elevation and are indicative of a corresponding difference in length of growing season between the lowland and upland regions.

Field observations have indicated an apparent higher precipitation on the east slope of the Riding Mountain than in other portions of the map area. This greater rainfall, which may be attributed to forced air lift over the elevated region, is also indicated by short-term records of summer precipitation that have been kept at the east gate of Riding Mountain National Park. During a ten year period, these records show an average of 2 inches more rainfall during the months of May to August than was recorded during the same period at Minnedosa. The more humid climate of the upland region is reflected in the forest vegetation.

D. VEGETATION

The area covered by the West-Lake map sheet lies within the Boreal Forest Region of Canada as delineated by Halliday.* Three sections of this Region occur within the West-Lake area and are designated as: Mixedwood Section, the Manitoba Lowlands Sections and the Aspen-Oak Section.

*Halliday, W. E. D. "A Forest Classification for Canada Forest Service". Bulletin 89. Canada Department of Mines and Natural Resources.

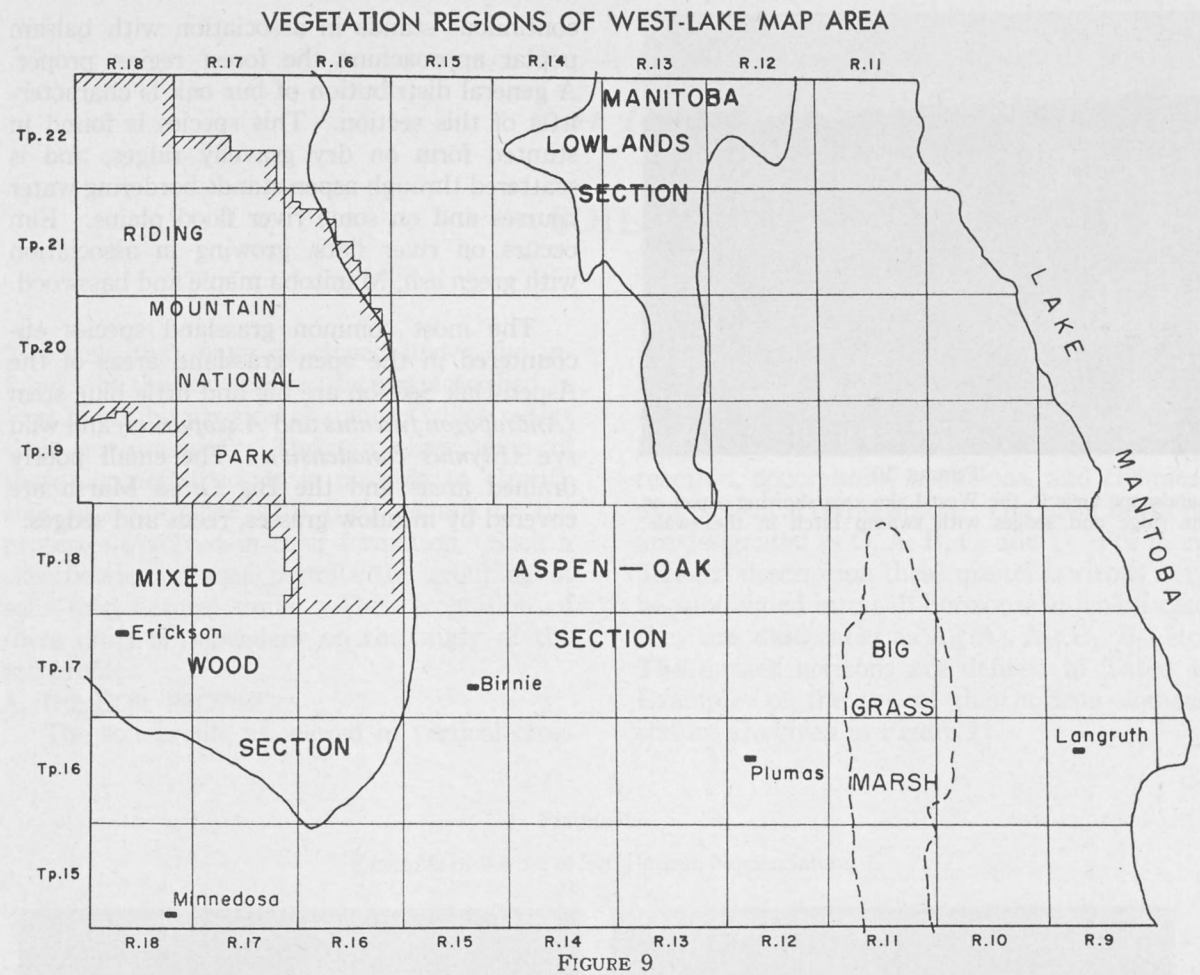


FIGURE 9

The Mixedwood Section occurs on the Riding Mountain and is characterized by a mixture of aspen, balsam poplar, white spruce and white birch. Large areas of well-developed aspen and balsam poplar associations occur towards the contact with the Aspen-Oak Section. Jack pine occur and tend to be the dominant species on sandy areas. Some sites are covered almost entirely by white spruce. The lower positions and water catchment areas develop black spruce and tamarack bogs. Areas of open grassland occur on very coarse textured deposits along the southwestern edge of Riding Mountain Park.

In the Manitoba Lowlands Section the prevailing forest cover is jack pine on the well-drained sandy ridges, tamarack on the very poorly drained sites, and aspen and balsam poplar associations in a pure state or mixed with white spruce on imperfectly to poorly drained sites. Bur oak is common on well-drained, coarse-textured soils. Some of the poorly drained areas are covered by reeds and sedges, along with scattered willow and swamp-birch.

The Aspen-Oak Section forms a broad transition zone between the Boreal Forest and Grassland Regions and has characteristics of both regions. Aspen is the prevalent species, ranging from small groves invading the grassland, through larger and irregular clumps, to

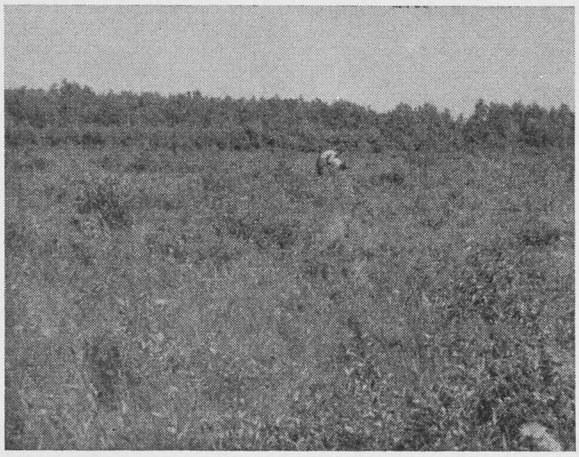


FIGURE 10
Landscape view in the West-Lake area showing aspen on the ridge and sedges with swamp birch in the swale.

continuous stands in association with balsam poplar approaching the forest region proper. A general distribution of bur oak is characteristic of this section. This species is found in stunted form on dry gravelly ridges, and is scattered through aspen stands bordering water courses and on some river flood plains. Elm occurs on river flats, growing in association with green ash, Manitoba maple and basswood.

The most common grassland species encountered in the open grassland areas of the Aspen-Oak Section are big and little blue stem (*Andropogon furcatus* and *A.scoparius*) and wild rye (*Elymus canadensis*). The small poorly drained areas and the Big Grass Marsh are covered by meadow grasses, reeds and sedges.

Part III.

SOILS

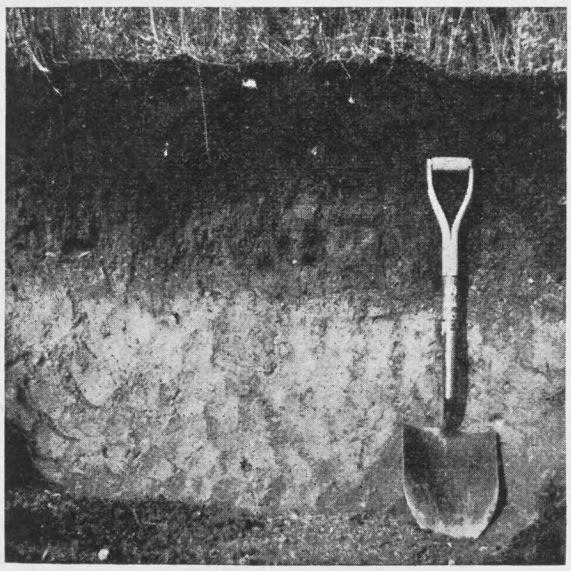
The soils that have developed under the influence of the soil forming factors described in Part II exhibit physical characters which reflect their environment. Through observation of these characteristics it is possible to classify soils in accordance with their genesis or the processes involved in their formation. Such a classification scheme permits the grouping of soils into natural units. The recognition of these units is dependent on the study of the soil profiles.

A. THE SOIL PROFILE

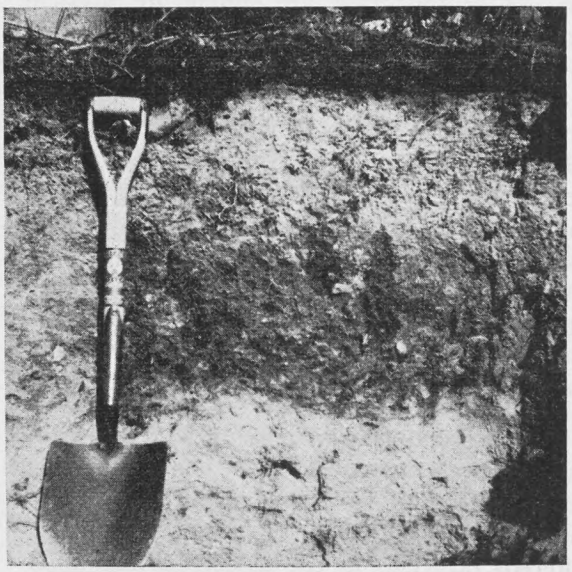
The soil profile as viewed in vertical cross section, consists of various soil layers. These layers are called soil horizons and differ from one another in one or more of the following features: color, texture, structure, consistence, reaction, concretions, intrusions, and chemical and biological composition. The main horizons are designated as O, A, B, C, and D. For more detailed description these master horizons may be subdivided into sub-horizons, in which case they are designated as A_1, A_2, A_3; B_1, B_2, etc. The master horizons are defined in Table 4. Examples of the use of this horizon nomenclature are given in Figure 11.

FIGURE 11

Examples of the use of Soil Horizon Nomenclature.



Black soil profile showing subdivision into soil horizons.



Grey Wooded soil profile showing subdivision into soil horizons.

TABLE 4

Definition of Soil Horizons

O HORIZON—Organic accumulation on the surface of the soil composed of leaf litter or thin muck and peat deposits.

A HORIZON—The horizon of maximum weathering and maximum removal of the products of weathering by downward movement of water. In grassland soils it is also the horizon of maximum accumulation of organic matter.

A_1 Sub-horizon—Surface mineral layer with maximum accumulation of organic matter; dark in color.

A_2 Sub-horizon—Layer of maximum leaching; light in color: prominent in most forest soils, absent in most grassland soils.

A_3 Sub-horizon—Transition layer to the B, but more like the A than the B.

B HORIZON—The horizon of less intense weathering. This subsurface horizon is characterized by: an accumulation of clay, iron, aluminum or organic matter; a blocky or prismatic structure; a color unlike that of the A or C horizons; or a combination of these features.

B_1 Sub-horizon—Transition layer to the A above, but more like the B than A. Sometimes absent.

B_2 Sub-horizon—Layer of maximum development of the features that characterize the B horizon.

B_3 Sub-horizon—Transition layer to the C, but more like the B than C. Sometimes absent.

C HORIZON—The horizon of relatively unweathered material, that is similar in composition to the material from which at least a portion of the overlying solum has developed. Slight alterations in the nature of this material due to accumulation of carbonates or soluble salts, or to the process of gleization are designated by the use of subscripts.

D HORIZON—Any stratum underlying the C, or the B if no C is present, which is unlike the material from which the solum (A and B horizons) has been formed.

LETTER SUBSCRIPTS

ca—Used to denote a whitish accumulation of carbonates (usually calcium carbonate) which most commonly occurs in the C horizon immediately below the B.

cs—Used to denote a visible accumulation of gypsum crystals (calcium sulfate) which may occur in any horizon but most commonly in the C.

g—Used to denote the process of gleization as indicated by greyish colors and reddish and brownish mottling. This condition is caused by oxidation and reduction processes associated with a fluctuating water table and may occur in any horizon.

B. SOIL CLASSIFICATION

The basic unit in most soil classification systems is the soil associate.* A soil associate consists of soils that are similar in physical features and chemical composition as revealed by profile characteristics. This similarity of profile features occurs only within areas of similar climate, vegetation, parent material, relief, drainage and age. Any significant variation in one or more of these soil forming factors causes dissimilarities of profile features and the soil is classified as a different associate. Individual soil associates may occupy large continuous land areas but more commonly are associated with other soils in a complex landscape pattern.

The associated soils occurring in a landscape pattern and developed from similar parent material form a soil association.* The soil associates that constitute the association occupy different positions in the landscape and differ in profile characteristics due to the local influence of drainage and vegetation. The soil association is recognized by the characteristics of the well or imperfectly drained associates which reflect the influence of regional climate and vegetation. When soils are developed from the same parent material but under a different climate and vegetation the better-drained associates exhibit different profile characteristics and another association is recognized.

When soils have similar profile characteristics but vary in some physical feature that is of importance to agriculture, the soils are classified as types or phases. Soil types are divisions based on variations in texture. Soil phases are based on external features such as topography and stoniness or the presence of an unconforming substrate.

C. SOIL MAPPING

The soils of the West-Lake map area were classified into soil associations, associates, types

*In some parts of Canada and in the United States, the "associate" is designated as "series" and the "association" as "catena".

TABLE 5

Key to the Classification of Soils in the West-Lake Map Area

Key to Associations	Acreage	% Total Map Area	Soil Associates or Local Soil Types Occurring in Association		
			Well-Drained Members	Imperfectly Drained Members	Poorly Drained Members
A. Soil Associations in which the Dominant Soil is a Black.					
1. Soils developed on medium textured till of shale, limestone and granitic rock origin:					Meadow
(1) Newdale association	72,046	4.86			Calcareous Meadow
(i) Newdale undulating phase	35,689	2.41		Black-Meadow	Saline Meadow
(ii) Newdale smooth phase	36,357	2.45	Black	Degrading Black-Meadow	Degrading Meadow
2. Soils developed on lacustrine deposits:					
(a) Medium textured deposits:					
(1) Carroll association	20,828	1.41			
(i) Carroll clay loam	12,741	0.86		Calcareous Black-Meadow	
(ii) Carroll clay loam, till substrate phase	8,087	0.55	Black	Black-Meadow	Calcareous Meadow
(2) Wellwood association Wellwood loam, till substrate phase	4,723	0.32	Black	Black-Meadow	Calcareous Meadow
(3) Tobarmore association	7,304	0.49	Degrading Black		
(i) Tobarmore loam to clay loam	6,612	0.44	Black	Black-Meadow	
(ii) Tobarmore, till substrate phase	691	0.05			
(b) Coarse textured deposits:					
(1) Stockton association	13,939	0.94	Degrading Black		
(i) Stockton loamy sand	5,460	0.37	Black	Black-Meadow	Meadow
(ii) Stockton fine sandy loam	6,636	0.45	Degrading Black Black	Black-Meadow	Meadow
(iii) Stockton fine sandy loam, till substrate phase	1,843	0.12		Black-Meadow	Calcareous Meadow Meadow
3. Soils developed on gravelly and coarse sandy deposits:					
(a) Deposits of limestone and granitic rock origin:					
(1) Agassiz association	53,845	3.63			
(i) Agassiz loamy sand	38,362	2.58			
(ii) Agassiz till substrate phase	14,031	0.95			
(iii) Agassiz sand substrate phase	1,452	0.10	Black	Black-Meadow	Calcareous Meadow
(b) Deposits of shale, limestone and granitic rock origin:					
(1) Marringhurst association	2,557	0.17	Black	Black-Meadow	Meadow
(2) Miniota association	2,396	0.16	Black	Black-Meadow	
B. Soil Associations in which the dominant soil is a Black-Meadow.					
1. Soils developed on medium textured, water worked till of limestone and granitic rock origin:					

TABLE 5

Key to the Classification of Soils in the West-Lake Map Area—(Continued)

Key to Associations	Acreage	% Total Map Area	Soil Associates or Local Soil Types Occurring in Association		
			Well-Drained Members	Imperfectly Drained Members	Poorly Drained Members
(1) Arden association	27,464	1.85			
(i) Arden loam	14,999	1.01			Saline Meadow
(ii) Arden gravel lens phase	12,465	0.84		Calcareous Black-Meadow	Calcareous Meadow
2. Soils developed on till of strongly acid shale and granitic rock origin:					Meadow
(1) Keld association	461	0.03		Black-Meadow	Peaty Meadow
3. Soils developed on thin lacustrine deposits underlain by till:					
(a) Medium textured deposits over sandy till					Saline Meadow
(1) McCreary association	20,506	1.38		Black-Meadow	Calcareous Meadow
(b) Medium textured deposits over shale clay till					Peaty Meadow
(1) Norgate association	5,921	0.40	Degrading Black	Black-Meadow	Calcareous Meadow
					Peaty Meadow
					Saline Meadow
(2) Kelwood association	3,525	0.24		Calcareous Black-Meadow	Calcareous Meadow
4. Soils developed on lacustrine deposits:					
(a) Fine textured deposits:					Saline Meadow
(1) Dauphin association	18,017	1.22			Peaty Meadow
(i) Dauphin clay	5,530	0.37		Black-Meadow	Calcareous Meadow
					Saline Meadow
(ii) Dauphin till substrate phase	12,488	0.85		Black-Meadow	Calcareous Meadow
(b) Medium textured deposits:					
(1) Lakeland association	184,205	12.43			
(i) Lakeland loam	53,568	3.61			
(ii) Lakeland loam, till substrate phase	17,073	1.15			
(iii) Lakeland clay loam	59,535	4.02			Saline Meadow
(iv) Lakeland clay loam, till substrate phase	54,029	3.65		Calcareous Black-Meadow	Peaty Meadow Calcareous Meadow
(c) Coarse textured deposits:					Saline Meadow
(1) Almasippi association	103,910	7.01			Calcareous Meadow
				Degrading Black-Meadow	Peaty Meadow
(i) Almasippi loamy fine sand	70,410	4.75		Black-Meadow	Meadow
(ii) Almasippi loamy fine sand, till substrate phase	29,261	1.97			Saline Meadow Peaty Meadow
(iii) Almasippi fine sandy loam	4,239	0.29		Black-Meadow	Calcareous Meadow
C. Soil Association in which the dominant soil is a Calcareous Meadow.					
1. Soils developed on fine textured lacustrine deposits underlain by clay to heavy clay loam till:					Solonchak Peaty Meadow
					Saline Meadow
(1) Westbourne association	8,548	0.58		Black Solonetz	Calcareous Meadow

TABLE 5

Key to the Classification of Soils in the West-Lake Map Area—(Continued)

Key to Associations	Acreage	% Total Map Area	Soil Associates or Local Soil Types Occurring in Association		
			Well-Drained Members	Imperfectly Drained Members	Poorly Drained Members
D. Soil Associations in which the dominant soil is a Degrading Black-Meadow.					
1. Soils developed on medium to coarse textured lacustrine deposits:					
(1) Onanole association	12,925	0.87			
(i) Onanole sandy loam	2,419	0.16			
(ii) Onanole clay loam	7,004	0.47	Dark Grey Wooded	Degrading Black-Meadow	
(iii) Onanole clay loam, till substrate phase	3,548	0.24	Dark Grey Wooded	Degrading Black-Meadow	Peaty Meadow Meadow
E. Soil Associations in which the dominant soil is a Dark Grey Wooded.					
1. Soils developed on boulder till:					
(a) Medium textured till of shale, limestone and granitic rock origin:					Grey Wooded Gley
(1) Erickson association	44,029	2.97	Dark Grey Wooded	Imperfectly drained Grey Wooded Degrading Black-Meadow	Degrading Meadow Peaty Meadow
(b) Medium textured till of dominantly shale origin:					
(1) Quercus association	1,267	0.09	Dark Grey Wooded	Degrading Black-Meadow	Meadow
(c) Fine textured till of dominantly shale origin:					Peaty Meadow
(1) Meadowbrook association	10,345	0.70	Solonetzic Dark Grey Wooded	Degrading Black-Meadow	Meadow
2. Soils developed on gravelly and coarse sandy deposits:					
(a) Deposits of limestone and granitic rock origin:					
(1) Leary association	12,695	0.86			
(i) Leary loamy sand	8,594	0.59			
(ii) Leary till substrate phase	1,221	0.08			Calcareous Meadow
(iii) Leary sand substrate phase	2,880	0.19	Dark Grey Wooded	Degrading Black-Meadow	Meadow
(b) Deposits of shale, limestone and granitic rock origin:			Degrading Black		
(1) Seech association	5,484	0.37	Dark Grey Wooded		
(c) Deposits dominantly shale in origin:			Degrading Black		
(1) Birnie association	2,811	0.19	Dark Grey Wooded		
F. Soil Associations in which the dominant soil is an Imperfectly Drained Dark Grey Wooded.					
1. Soils developed on coarse textured lacustrine deposits:					
(1) Selina association	48,522	3.27			
(i) Selina sand	34,007	2.29			Calcareous Meadow
(ii) Selina sand, till substrate phase	14,515	0.98	Grey Wooded	Imperfectly drained Dark Grey Wooded	Peaty Meadow Meadow

TABLE 5

Key to the Classification of Soils in the West-Lake Map Area—(Continued)

Key to Associations	Acreage	% Total Map Area	Soil Associates or Local Soil Types Occurring in Association		
			Well-Drained Members	Imperfectly Drained Members	Poorly Drained Members
G. Soil Associations in which the dominant soil is a Grey Wooded.					
1. Soils developed on boulder till:					
(a) Medium textured till of shale, limestone and granitic rock origin:					
(1) Waitville association	36,795	2.48	Grey Wooded	Imperfectly drained Grey Wooded	Grey Wooded Gley Degrading Meadow Peaty Meadow
(2) Granville association	31,427	2.12	Grey Wooded	Imperfectly drained Grey Wooded Degrading Black-Meadow	Grey Wooded Gley Peaty Meadow
(b) Medium textured till of dominantly limestone origin:					
(1) Garson complex	23,846	1.61	Grey Wooded Degrading Rendzina	Imperfectly drained Grey Wooded Imperfectly drained Degrading Rendzina	Peaty Meadow Calcareous Meadow
(c) Medium textured till of dominantly shale origin:					
(1) Clarksville association	18,109	1.22	Grey Wooded	Imperfectly drained Grey Wooded	Grey Wooded Gley Peaty Meadow
(d) Fine textured till of dominantly shale origin:					
(1) Blackstone association			Grey Wooded	Imperfectly drained Grey Wooded	Peaty Meadow
2. Soils developed on thin shaly drift deposits over shale rock:					
(1) Wapus association	4,631	0.31	Grey Wooded	Imperfectly drained Grey Wooded	Grey Wooded Gley Peaty Meadow
3. Soils developed on medium and coarse textured lacustrine deposits:					
(1) Rackham association	8,317	0.56			
(i) Rackham sandy loam	3,963	0.26			
(ii) Rackham sandy loam, till substrate phase	230	0.02			
(iii) Rackham clay loam	553	0.04			
(iv) Rackham clay loam, till substrate phase	3,571	0.24	Grey Wooded	Imperfectly drained Grey Wooded	Peaty Meadow Grey Wooded Gley
4. Soils developed on gravelly and coarse sandy deposits:					
(1) Zaporoza association	3,041	0.21	Grey Wooded	Imperfectly drained Grey Wooded	
H. Soil Associations in which the dominant soil is a Rendzina.					
1. Soils developed on boulder till of dominantly limestone origin:					
(1) Isafold association	471,568	31.82	Rendzina	Imperfectly drained Rendzina	Peaty Meadow Saline Meadow Calcareous Meadow

TABLE 5

Key to the Classification of Soils in the West-Lake Map Area—(Continued)

Key to Associations	Acreage	% Total Map Area	Soil Associates or Local Soil Types Occurring in Association		
			Well-Drained Members	Imperfectly Drained Members	Poorly Drained Members
I. Alluvial soils.					
1. Soils developed on slightly to moderately calcareous deposits:					
(1) Edwards association	51,679	3.49			
(i) Edwards silt loam to silty clay	35,113	2.37	Moderately well drained soils occur near the stream channels, but imperfectly and poorly drained soils occupy the flat areas behind the river levees.		
(ii) Edwards shaly phase	9,769	0.66			
(iii) Edwards semi-mature phase	5,276	0.36			
(iv) Edwards semi-mature, till substrate phase	1,521	0.10			
2. Soils developed on moderately to strongly calcareous deposits:					
(1) Gladstone association	2,949	0.20			
(i) Gladstone silt loam to silty clay	2,143	0.15	Soils are dominantly imperfectly drained, but poorly drained members occur on the finer textured deposits.		
(ii) Gladstone semi-mature phase	806	0.05			
3. Soils developed on variable textured deposits in the Minnedosa River Valley:					
(1) Assiniboine complex	2,465	0.17	Soils are imperfectly and poorly drained.		
4. Soils developed on fine textured deposits surrounding small lakes in the Riding Mountain area.					
(1) Proven Lake association	184	0.01	Soils are dominantly poorly drained, but some imperfectly drained members occur.		
J. Organic soils.					
1. Organic deposits 12 to 30 inches thick:					
(1) Half Bog	74,327	5.01	Very poorly drained soils.		
2. Organic deposits over 30 inches thick:					
(1) Bog	13,594	0.92	Very poorly drained soils.		
K. Unclassified soils.					
1. Truncated soils, lithosols and regosols on steep slopes:					
(1) Eroded Slopes complex	28,247	1.91	Excessively drained soils.		
2. Black and Degrading Black soils of variable texture developed on benchlands in river valleys:					
(1) Benchlands complex	3,064	0.20	Well, imperfectly and poorly drained soils occur.		
3. Water	19,538	1.32			

and phases. However, as this was a reconnaissance survey it required a small mapping scale to cover the large area of the map sheet, and it was impossible to show each individual kind of soil as a unit. For this reason the soils were grouped into mapping units which permitted the presentation of the most detailed information possible under the mapping scale. The soil association was the primary mapping unit utilized in the preparation of the soil map. Where single associates, types or phases occupy large continuous areas they are shown separately. Where the soils have been developed from intermixed parent materials they were mapped as a complex.

In conducting this survey a traverse was made along each road allowance, thus giving lines of traverse one mile apart and permitting the observation of at least two sides of each quarter section. Foot traverses inside the sections were made only if some important detail was required which could not be obtained from the ordinary lines of traverse. Along the lines of traverse the soils were examined at one-quarter to one half mile intervals, or more frequently if closer inspection was indicated. Aerial photographs were utilized in the mapping of the West-Lake soils. These aerial photographs aid in plotting soil boundaries in a reconnaissance survey through the identification of land patterns by comparing photographic detail with visual observations of the landscape.

D. FIELD CLASSIFICATION AND DESCRIPTION OF THE SOILS OF THE WEST-LAKE MAP AREA

A key to the soils of the West-Lake map area is presented in Table 5. The soil associations are arranged into groups on the basis of the genetic type of the dominant soil associate and on the kind of materials from which the associations have been developed. The associated genetic soil types that occur in each association are listed by soil drainage classes. A description of the profile features that characterize each of the genetic soil types recognized in the West-Lake map area is given in Table 6.

The soil association descriptions are presented according to their order in the key. A description of the texture, parent material, topography, drainage and vegetation is presented for each association. A detailed profile description of the dominant associate is given and the occurrence and distribution of other associated genetic types are noted. The fertility, land-use pattern, problems and recommended cultural practices are described for each soil association.

TABLE 6

Description of Genetic Soil Types Occurring in the West-Lake Map Area

Profile Type	Horizon	Description
WELL-DRAINED AND MODERATELY WELL DRAINED SOILS		
Black		Modal Black soils developed under tall prairie grass vegetation.
	A	Thick, very dark grey to black horizon, high in organic matter, granular, friable, neutral in reaction.
	B	Brownish horizon with little or no clay accumulation, granular to sub-angular blocky, friable to firm, neutral to mildly alkaline in reaction.
	C	A whitish Cca sub-horizon of calcium carbonate accumulation usually occurs below the B horizon and this grades into relatively unaltered parent material.
Degrading Black		A Black soil which shows some indications of degradation under woods, being an intergrade to the Dark Grey Wooded soil.
	O	Thin, partially decomposed leaf and sod mat.
	A	Very dark grey to dark grey horizon, granular, friable, neutral to slightly acid in reaction.
	B	Brownish horizon of slight clay accumulation, sub-angular blocky to blocky, firm to very firm, neutral to slightly acid in the B_1 and B_2 horizons to mildly alkaline in the B_3.

TABLE 6

Description of Genetic Soil Types Occurring in the West-Lake Map Area—Continued

Profile Type	Horizon	Description
WELL-DRAINED AND MODERATELY WELL DRAINED SOILS —(Continued)		
	C	A whitish Cca sub-horizon of calcium carbonate accumulation usually occurs below the B horizon and this grades into unaltered parent material.
Grey Wooded		Modal Grey Wooded soils developed under deciduous and coniferous forest.
	O	Partially decomposed leaf mat.
	A_1	Very thin or absent, very dark grey horizon, granular, friable, slightly acid in reaction.
	A_2	Grey leached horizon, usually platy, friable to firm, slightly acid to medium acid in reaction.
	A_3	Greyish brown transitional horizon, more like the A than the B.
	B_1	Greyish brown transitional horizon, more like the B than the A.
	B_2	Dark greyish brown horizon of clay accumulation, subangular blocky, very firm, slightly to medium acid in reaction.
	B_3	Greyish brown transitional horizon, neutral to slightly alkaline in reaction.
	C	A whitish Cca horizon of calcium carbonate accumulation usually occurs below the B horizon and this grades into relatively unaltered parent material.
Dark Grey Wooded		A weakly developed Grey Wooded soil, being an intergrade to the Degrading Black soils.
	O	Thin, partially decomposed leaf mat.
	A_1	Thin or absent, very dark grey horizon, granular, friable, neutral to slightly acid in reaction.
	A_2	Dark grey to grey, leached horizon, granular to platy, friable, slightly acid in reaction.
	A_3	Greyish brown transitional horizon, more like the A than the B horizon.
	B_1	Greyish brown transitional horizon, more like the B than the A horizon.
	B_2	Dark greyish brown horizon of clay accumulation, sub-angular blocky to blocky, very firm to firm, slightly acid in reaction.
	B_3	Greyish brown transitional horizon, mildly alkaline to neutral in reaction.
	C	A whitish Cca horizon of calcium carbonate accumulation usually occurs below the B horizon and this grades into relatively unaltered parent material.
WELL-DRAINED AND MODERATELY WELL DRAINED SOILS —(Continued)		
Solonetzic Dark Grey Wooded		A Dark Grey Wooded soil which has prismatic or columnar structure in the B horizon (similar to that found in Solonetz and Solodized-Solonetz soils).
Rendzina		A Regosolic soil developed from parent material that is very high in calcium carbonate content (over 40% $CaCO_3$ equivalent).
	A	Very dark grey to dark grey horizon which is thin in comparison with Black soils, granular, friable, alkaline in reaction. Grades sharply into:
	C	Whitish parent material, very high in lime carbonate content.
Degrading Rendzina		Thin, degrading soils developed under forest from parent material that is very high in calcium carbonate content (over 40% $CaCO_3$ equivalent).
	O	Thin, partially decomposed leaf mat.
	A_1	Thin or absent, very dark grey horizon, granular, friable, neutral in reaction.
	A_2	Dark grey to grey, leached horizon, granular to platy, friable, neutral to slightly acid in reaction. Grades sharply into:
	B	Greyish brown horizon of clay accumulation, sub-angular blocky to blocky, firm to very firm, neutral to mildly alkaline in reaction. Grades sharply into:
	C	Whitish parent material very high in lime carbonate content.
IMPERFECTLY DRAINED SOILS		
Black-Meadow		Imperfectly drained Black soils, being an intergrade to the Meadow soil.
	A	Thick, very dark grey to black horizon, high in organic matter, granular, friable, neutral to mildly alkaline in reaction.
	B	Thin or absent, weakly developed, brownish horizon, granular, friable, mildly alkaline, slightly iron stained.
	C	A whitish Cca sub-horizon of calcium carbonate accumulation usually occurs below the B horizon and this grades into unaltered parent material. The C horizon is gleyed.

TABLE 6

Description of Genetic Soil Types Occuring in the West-Lake Map Area—Concluded

Profile Type	Horizon	Description
IMPERFECTLY DRAINED SOILS—(Continued)		
Calcareous Black-Meadow		Imperfectly drained Calcareous Black soils which are similar to the Black-Meadow intergrade soils except for the presence of free lime carbonate in the A horizon (B horizon is usually absent).
Degrading Black-Meadow		Imperfectly drained Degrading Black soils which show some indications of woodland degradation.
	O	Thin, partially decomposed leaf and sod mat.
	A	Very dark grey to dark grey horizon, granular, friable, neutral to slightly acid in reaction.
	B	Brownish horizon of slight clay accumulation, sub-angular blocky to blocky, firm, neutral to mildly alkaline in reaction, slightly iron stained in the lower portion.
	C	Gleyed parent material.
Imperfectly Drained Grey Wooded		A Grey Wooded soil that shows indications of imperfect drainage by the presence of reddish iron mottles in the B and C horizons.
Imperfectly Drained Dark Grey Wooded		A Dark Grey soil that shows indications of imperfect drainage by the presence of reddish iron mottles in the B and C horizons.
Imperfectly Drained Rendzina		A Rendzina soil that shows indications of imperfect drainage by the presence of free lime carbonate in the A horizon and iron mottles in the upper portion of the C horizon.
Imperfectly Drained Degrading Rendzina		A Degrading Rendzina soil that shows indications of imperfect drainage by the presence of iron mottles in the B and C horizons.
Black Solonetz		A Halomorphic soil developed under salt tolerant vegetation and formed from saline parent material during the process of desalinization.
	A	Thin, very dark grey horizon which may be blotched with lighter colored material due to leaching, granular, friable, neutral in reaction.
	B	Thick, dark grey to dark greyish brown horizon, prismatic, very firm, neutral to mildly alkaline in reaction.
	C	Saline parent material, commonly with a whitish layer of lime carbonate accumulation below the B horizon and a zone of salt concentration lower in the profile.
POORLY DRAINED SOILS		
Meadow		Modal Meadow soils developed under swale grass and sedge vegetation.
	A	Very dark grey to black horizon, high in organic matter, granular, friable, neutral to slightly alkaline in reaction. Usually slightly gleyed but mottling is masked by dark color.
	C	Gleyed parent material. May have a distinct gley horizon or be diffusely mottled throughout.
Calcareous Meadow		Meadow soils that contain free lime carbonate in the A horizon.
Peaty Meadow		Meadow soils that have a surface layer of peat or muck up to 12 inches thick.
Saline Meadow		Meadow soils that contain soluble salts in the A horizon.
Solonchak		Soils with a high concentration of soluble salts throughout. Vegetation is sparse, consisting of salt-tolerant plants. Profile development is absent or limited to the formation of a thin, dark grey A horizon.
Grey Wooded Gley		Grey Wooded-like soils developed under alternating wet and dry conditions.
	O	Mucky leaf and sod mat.
	A_1	Thin, dark grey horizon, granular, friable, slightly acid in reaction.
	A_2	Grey, leached horizon, usually platy, friable to firm, slightly acid in reaction, contains iron mottles.
	A_3	Greyish brown transitional horizon, more like the A than the B horizon.
	B_1	Greyish brown transitional horizon, more like the B than the A horizon.
	B_2	Dark greyish brown horizon of clay accumulation, blocky, very firm, slightly acid in reaction, contains iron mottles.
	B_3	Greyish brown transitional horizon, neutral to slightly alkaline in reaction. Grades into:
	C	Gleyed parent material, strongly mottled with iron and contains free lime carbonate.
Degrading Meadow		A Meadow soil that shows indications of woodland degradation, being an intergrade to the Grey Wooded Gley soil.

SOIL ASSOCIATIONS IN WHICH THE DOMINANT SOIL IS A BLACK

NEWDALE ASSOCIATION (72,046 acres)

The Newdale loam to clay loam soils are developed on medium textured, moderately calcareous boulder till of mixed limestone, shale and granitic rock origin. Stones occur throughout the Newdale soil area, but constitute a problem to cultivation only in local areas bordering creek and river channels.

The topography of the Newdale association is irregular and varies from nearly level to moderately undulating. Soil drainage is variable. Run-off waters from the knolls and ridges either accumulate in enclosed depressions or drain away through meandering, shallow channels. The native vegetation is predominantly grassland interspersed with aspen groves. Aspen and willow grow around the marshy depressions.

Two topographic phases of the Newdale association occur in this map area. These divisions are shown on the map and will be described as (i) Newdale undulating phase and (ii) Newdale smooth phase.

(i) *Newdale undulating phase* (35,689 acres)

The topography of the Newdale undulating phase varies from roughly undulating to nearly level, but is characteristically moderately undulating (irregular gently sloping). This soil area is marked by very numerous sloughs and small lakes. As the topography is irregular and undrained depressions are numerous, several different soil associates may occur within the same field. The typical soils of the Newdale undulating phase, which are found in well-drained positions on gentle slopes, are Black soils and may be described as follows:

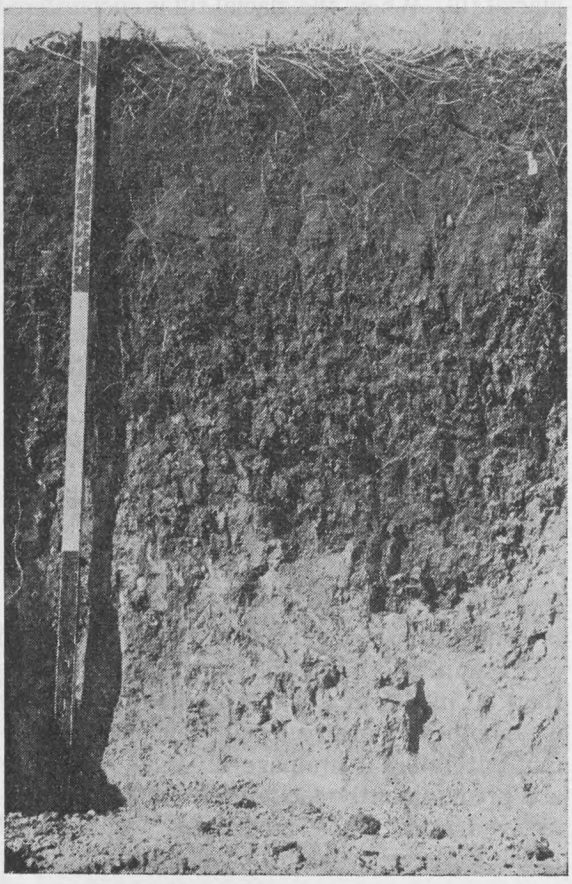


FIGURE 12

Soil profile of Newdale clay loam. A Black soil developed on moderately calcareous till. (Measuring stick interval = 12 inches.)

A —6 to 10 inches, very dark grey loam to clay loam; finely granular; friable when moist, slightly hard when dry; neutral in reaction.

B —5 to 8 inches, clay loam to heavy clay loam; dark greyish brown fine blocky aggregates which are brown inside; firm when moist, hard when dry; neutral to mildly alkaline in reaction. Grades sharply into:

Cca—5 to 12 inches, very pale brown loam to clay loam; fine granular; friable when moist, cemented when dry; mildly alkaline, strongly calcareous. Fades gradually into:

C —Light brownish grey, loam to clay loam boulder till; pseudo-fragmental; plastic and sticky when wet, weakly cemented when dry; mildly alkaline, moderately calcareous.

Black-Meadow and Degrading Black-Meadow soils are found as narrow bands around the edge of the depressions and along the margins of broad shallow draws. The soils which occur in depressions and shallow draws are of four types: Meadow, Calcareous Meadow, Saline Meadow and Degraded Meadow associates. These Meadow soils often are developed on modified parent materials consisting of a thin deposit of lacustrine sediments over the boulder till.

(ii) *Newdale smooth phase* (36,357 acres)

The topography of the Newdale smooth phase is relatively smooth in comparison with the undulating phase. In the West-Lake area these soils occur principally along the broad sloping face of the south-eastern portion of Riding Mountain. The till plain is marked by numerous shallow channels and draws. Although surface runoff is good, internal drainage is slow and a large portion of the soil area is imperfectly drained. The dominant moderately well drained to imperfectly drained Black-Meadow soil may be described as follows:

A —4 to 9 inches, very dark grey loam to clay loam; finely granular; friable when moist, slightly hard when dry; mildly alkaline in reaction.
B —1 to 4 inches, very dark greyish brown loam to clay loam; fine subangular blocky; friable when moist, hard when dry; mildly alkaline, very weakly calcareous.
Cca—3 to 10 inches, very pale brown loam to clay loam; finely granular; friable when moist, cemented when dry; alkaline, strongly calcareous.
C —Light yellowish brown, loam to clay loam boulder till; pseudo-fragmental; plastic and sticky when wet, cemented when dry; alkaline, moderately calcareous; iron stained and may contain some gypsum crystals.

Associated soils include: Black soils on the better drained slopes and Meadow, Calcareous Meadow and Saline Meadow soils which may occur along runways or in slight depressions.

Agriculture: The better drained Newdale soils are naturally fertile and are well suited to the production of grain and forage crops. They have good water retention capacity, neutral to slightly alkaline reaction, and a good reserve of organic matter.

The agricultural value and adaptability of any individual parcel of land is dependent on the local topography as it affects the distribution of the soil associates. Areas with smooth topography and relatively few sloughs and potholes are suited to the cultivation of large fields for grain production. Areas with irregular topography and numerous sloughs and potholes are difficult to cultivate by large fields but a mixed farming enterprise provides for the utilization of both the arable and non-arable land. The shallow channels and draws along the sloping face of Riding Mountain should be permanently seeded to grasses and legumes to minimize water erosion.

CARROLL ASSOCIATION (20,828 acres)

The Carroll association of soils is developed on shallow lacustrine deposits, which are underlain at varying depths by moderately calcareous glacial till. Where the glacial till is encountered within 30 inches of the surface, the soils are classified as Carroll clay loam, till substrate phase. The surface texture is predominantly silty clay loam but varies from very fine sandy loam to clay loam.

The topography varies from nearly level to very gently sloping. Surface drainage varies in accordance with the topography, but internal percolation is slow throughout the area. The native vegetation was predominantly meadow-prairie grasses with aspen and willow growing in groves and along drainage channels.

The soils of the Carroll association are shown on the soil map and are described under: (i) Carroll clay loam, and (ii) Carroll clav loam, till substrate phase.

(i) *Carroll clay loam* (12,741 acres)

The Carroll clay loam soils are developed on medium textured lacustrine deposits of more than 30 inches in thickness. The topography is smooth and nearly level. Surface runoff is fair but internal drainage is poor. The soils are predominantly moderately well to imperfectly drained. The moderately well drained Black soil may be described as follows:

A —8 to 12 inches, very dark grey silty clay loam; granular; friable when moist, slightly hard when dry; neutral to mildly alkaline.

AB—2 to 4 inches, dark greyish brown loam to clay loam; granular; friable when moist, hard when dry; mildly alkaline, very weakly calcareous.

Cca—6 to 10 inches, pale to very pale brown loam to clay loam; fine pseudo-granular; friable when moist, slightly cemented when dry; alkaline, strongly calcareous.

C —Yellow to light olive brown loam to clay loam; fine pseudo-granular; friable when moist, slightly cemented when dry; alkaline, moderately calcareous, weakly iron stained.

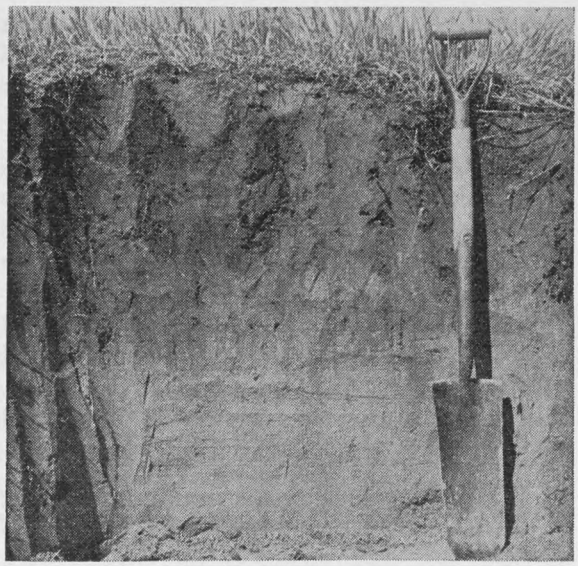


FIGURE 13

Soil profile of Carroll silty clay loam. A Black soil developed on medium textured lacustrine deposits.

The associated soils include: Black-Meadow and Calcareous Meadow soils.

(ii) *Carroll clay loam, till substrate phase* (8,087 acres)

The Carroll clay loam, till substrate phase soils are developed on medium textured lacustrine deposits less than 30 inches thick which lie over boulder till. The topography is smooth and level to very gently undulating. Internal drainage is slow but surface runoff is fair to good and the soils are dominantly moderately well drained Blacks.

The solum of the soil profile is usually developed in the silty clay loam mantle but in some places it has been developed partly within the underlying till. On slight knolls, where the lacustrine mantle is thin, the soils resemble the moderately well drained Black, Newdale smooth phase soils. On slopes and in slight depressions the soils have profile characteristics similar to the Black, Black-Meadow or Meadow soil types which are common to the Carroll clay loam area.

Agriculture: The Carroll soils are naturally fertile and are suited to the production of all crops common to the region. They have a good reserve of organic matter, a neutral to mildly alkaline reaction, good water retention capacity and excellent tilth.

The Carroll soils are utilized almost exclusively for grain production. Large continuous fields suitable to large equipment are being farmed. Water erosion is not a problem as the soil areas are nearly level, however suitable cultural practices must be followed to avoid soil erosion by wind. With good management, the Carroll soils in this area can be maintained at a high level of productivity.

WELLWOOD ASSOCIATION (4,723 acres)

The Wellwood association is developed on medium textured lacustrine deposits which normally overlie stratified sand. However the portions of this soil association which occur adjacent to the Arden soils in the West-Lake area are underlain by boulder till at shallow depths and are classified as a till substrate phase.

(i) *Wellwood loam, till substrate phase* (4,723 acres)

These soils, which have developed on a thin lacustrine mantle over till, are dominantly loam

in texture but vary from very fine sandy loam to clay loam. A few surface stones are encountered where the lacustrine mantle over the till is thin.

The topography is level with the exception of local sloping areas bordering stream channels and their confluent draws. Internal drainage is impeded by the till substrate and the soils are dominantly moderately well to imperfectly drained. The native vegetation was composed of large aspen and willow groves intermixed with open areas of tall-prairie grass vegetation. The representative moderately well drained Black soil may be described as follows:

A —7 to 12 inches, very dark grey loam; granular; friable when moist, slightly hard when dry; neutral in reaction.

B —6 to 12 inches; dark greyish brown loam; subangular blocky; friable when moist, hard when dry; mildly alkaline.

Cca—8 to 12 inches, pale brown loam, granular; friable when moist, weakly cemented when dry; alkaline, moderately calcareous.

D —Light grey to pale brown, clay loam boulder till; pseudo-fragmental; firm when moist, hard when dry; alkaline, strongly calcareous; iron stained.

Associated soils include: Black-Meadow and Calcareous Meadow soils.

Agriculture: The Wellwood soils are naturally fertile and are suited to the production of all regionally adapted crops. They have a fair to good reserve of organic matter, a favorable reaction, and a fair to good water retention capacity.

Grain growing is the dominant farm enterprise on these soils although beef cattle are raised on many farms, especially in areas bordering the less fertile, sandy Stockton soils.

TOBARMORE ASSOCIATION (7,304 acres)

The Tobarmore soils are developed on medium textured, shaly alluvial fan deposits which occur along the east face of the Riding Mountain. The surface texture ranges from very fine sandy loam to clay loam with the coarser textures predominant.

The topography is smooth and level to very gently sloping. A few shallow ravines cross the soil area. Soil drainage is good as surface runoff and internal percolation are both good. Under native conditions the vegetation was predominantly tall prairie grasses with aspen and oak woods occurring along the ravines and in groves on the level plain.

The dominant Black soil of the Tobarmore association may be described as follows:

A —10 to 16 inches, very dark grey fine sandy clay loam; granular; friable when moist, hard when dry; neutral to mildly alkaline in reaction. May grade through a weakly developed B horizon but usually grades directly into:

Cca—5 to 10 inches, greyish brown fine sandy loam; weakly fine granular; very friable when moist, weakly cemented when dry; moderately alkaline, moderately calcareous.

C —Greyish brown loamy fine sand; weakly fine granular to structureless; very friable to loose when moist, weakly cemented when dry; mildly alkaline, weakly calcareous. The sand portion of the parent material contains a large percentage of shale fragments.

Associated soils include: Degrading Black soils, occurring principally along stream channels, and Black-Meadow soils occurring in localized depressional area.

Two small areas of about 700 acres were mapped as Tobarmore, till substrate phase. These soils have a substrate of boulder till within 30 inches of the surface. Otherwise they are similar to the modal Tobarmore soils.

Agriculture: The Tobarmore soils are naturally fertile. They have a fair reserve of organic matter and a neutral to slightly alkaline reaction. However, they have only a fair water retention capacity and crops on these soils are subject to drought in dry years.

These soils are utilized almost entirely for grain production. Beef cattle are a secondary enterprise on some farms where they utilize nonarable lands along ravines for grazing purposes. The chief soil problem is wind erosion as the soil aggregates pulverize readily. The erosion hazard can be minimized by the use of field shelterbelts and suitable cultural practices.

STOCKTON ASSOCIATION (13,939 acres)

The Stockton soils are developed on sandy deltaic deposits. The surface texture varies from sand to very fine sandy loam. Occasional surface stones occur only in areas adjacent to the Arden soils where the sandy deposit is thin.

The topography is nearly level to very gently undulating. Soil drainage is good, except in areas where a till substrate within a few feet of the surface impedes internal drainage. The native vegetation is aspen groves intermixed with small areas of tall-prairie grasses.

The Stockton association has been divided into two textural types and a till substrate phase of one of these types. These divisions are: (i) Stockton loamy sand, (ii) Stockton fine sandy loam, and (iii) Stockton fine sandy loam, till substrate phase.

(i) *Stockton loamy sand* (5,460 acres)

The surface texture of the Stockton loamy sand varies from sand to loamy fine sand. The representative Stockton loamy sand soil is a weakly developed Black and may be described as follows:

A —6 to 12 inches, very dark greyish brown loamy sand; weakly granular to structureless; very friable to loose; neutral in reaction.

AB—2 to 4 inches, dark greyish brown loamy sand; structureless; loose, neutral in reaction.

B —5 to 18 inches, brown sand; structureless; loose; neutral in reaction.

C —Yellowish brown sand; structureless; loose; neutral to mildly alkaline in reaction.

Associated soils include: Degrading Black, Black-Meadow and Meadow soils. The Degrading Black and Black-Meadow soils constitute a large portion of the association, whereas the Meadow soils are small in extent.

(ii) *Stockton fine sandy loam* (6,636 acres)

The surface texture of the Stockton fine sandy loam varies from loamy sand to very fine sandy loam. These soils in the West-Lake area are dominantly imperfectly drained, Black-Meadow soils with profile characteristics as shown in Figure 14, on page 44.

Associated soils include small areas of Black, Degrading Black and Meadow types.

(iii) *Stockton fine sandy loam, till substrate phase* (1,843 acres)

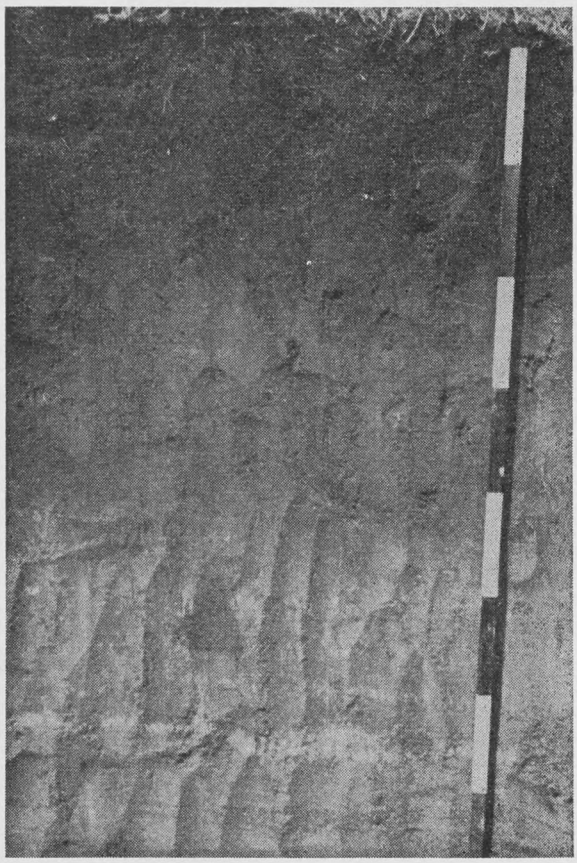
The Stockton till substrate phase soils are developed on a shallow mantle of sandy lacustrine deposits underlain by till. As internal drainage is impeded, the soils are dominantly imperfectly and poorly drained. Black-Meadow, Meadow and Calcareous Meadow soils constitute the entire area of these soils occurring in the West-Lake area.

Agriculture: The Stockton soils are low in natural fertility and their agricultural value is further limited by their susceptibility to wind erosion. They have a low organic matter reserve which may be rapidly depleted under cultivation through removal of the fine organic particles by wind action. They have low water-retention capacity and consequently crops are subject to periodic drought. Their agricultural adaptability varies with surface texture.

The Stockton loamy sand soils should only be used sparingly for grain production, due to their low fertility and high susceptibility to wind erosion. They are better adapted to utilization as grazing land, especially when sown to drought resistant grass species such as crested wheat grass.

The Stockton fine sandy loam soils are better suited to cultivation than are the Stockton loamy sands. Grains can be grown, but special practices are needed to prevent severe loss of soil productivity through wind erosion. A mixed farming enterprise with emphasis on livestock production is most suitable for these soils.

Crops grown on the Stockton fine sandy loam, till substrate phase soils are less subject to drought than those on Stockton fine sandy loam, but these soils are otherwise similar in their agricultural adaptability.



A —6 to 18 inches, very dark grey fine sandy loam; weakly granular; friable when moist, slightly hard when dry; neutral to mildly alkaline in reaction.

B —7 to 15 inches, greyish brown loamy fine sand; structureless; loose, alkaline, very weakly calcareous in lower portion.

C —Pale brown fine sand; structureless; loose; alkaline, weakly calcareous, iron stained.

FIGURE 14

Soil profile of Stockton fine sandy loam. A Black soil developed on sandy deltaic deposits. (Measuring stick interval = 6 inches.)

AGASSIZ ASSOCIATION (53,844 acres)

The Agassiz soils are developed on gravel and coarse sandy deposits, chiefly of limestone and granitic rock origin. Surface textures vary from sand to fine sandy loam but are characteristically loamy sand. The texture of the soils becomes coarser with depth. A sand or till substrate within thirty inches of the surface is encountered in some areas.

The Agassiz soils generally occur on beach ridges with rounded form but may occur on level gravel plains. The upper portions of the beach ridges and the thick gravel plain deposits are well drained, but imperfect to poor drainage is encountered along the edges of the beach ridges and in areas with thin gravel deposits underlain by till and sand. The native vegetation consists of mixed prairie grasses and herbs with occasional oak trees on the well-drained soils and aspen-balsam poplar and willow vegetation on imperfectly to poorly drained soil areas.

The Agassiz soils have been divided into: (i) Agassiz loamy sand, (ii) Agassiz loamy sand, till substrate phase and (iii) Agassiz loamy sand, sand substrate phase.

(i) *Agassiz loamy sand* (38,362 acres)

The representative Agassiz soil is a weakly developed Black and has the following profile characteristics:

A —4 to 8 inches, very dark grey loamy sand; structureless; loose, mildly alkaline in reaction.

B —3 to 7 inches, greyish brown sand to coarse sand; structureless; loose, alkaline in reaction.

Cca—5 to 8 inches, pale brown coarse sand to gravel; structureless; loose, alkaline and weakly calcareous; pebbles are coated with lime carbonate on the underside.

C —Stratified coarse sand and gravel; structureless; loose; mildly alkaline in reaction.

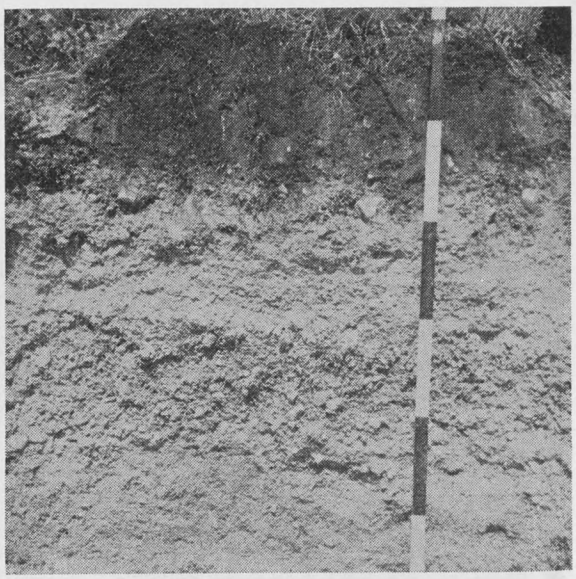


FIGURE 15

Soil profile of Agassiz sandy loam. A weakly developed Black soil developed on sand and gravel outwash. (Measuring stick interval = 6 inches.)

Black-Meadow and Calcareous Meadow soils occur along the margins of the gravel beaches.

(ii) *Agassiz loamy sand, till-substrate phase* (14,031 acres)

The predominant genetic type in this phase is a Black-Meadow soil. Soil drainage is imperfect as the till substrate impedes internal percolation. The soil profile has a 5 to 10 inch, very dark grey A horizon that is loamy sand in texture, weakly fine granular, very friable and mildly alkaline in reaction. The A horizon grades sharply into the Cca horizon which is developed in weakly iron stained coarse sand and gravel. A till substrate occurs within thirty inches of the soil surface. Associated soils include: Black, and Calcareous Meadow soils.

(iii) *Agassiz loamy sand, sand-substrate phase* (1,452 acres)

The predominant soil type in this phase is a Black-Meadow soil. The topography is flat and boulder till, which occurs under the sandy substrate at several feet in depth, impedes internal drainage. The soil profile is similar to the Agassiz loamy sand, till substrate phase with the exception that a sandy substrate occurs under the gravel deposit. Associated soils include Calcareous Meadow and Black soils.

Agriculture: The Agassiz soils have low natural fertility. They have a low organic matter reserve and very low moisture-retention capacity. They are best utilized as pasture, but their carrying capacity is low. The gravel ridges provide an excellent source of material for road ballast and building purposes.

MARRINGHURST ASSOCIATION (2,557 acres)

The Marringhurst soils are developed on gravel and coarse sandy out wash deposits of shale, limestone and granitic rock origin. The surface texture varies from loamy coarse sand to sandy loam but the coarser textures predominate. The texture of the soil commonly becomes coarser with depth.

The topography is level to gently undulating. The soils are dominantly well to somewhat excessively drained as internal percolation is rapid. The native vegetation is mixed prairie grasses and associated herbs on well-drained sites and meadow-grasses associated with willow and aspen on the poorly drained sites.

The well-drained Marringhurst soils are weakly developed Black soils which may be described as follows:

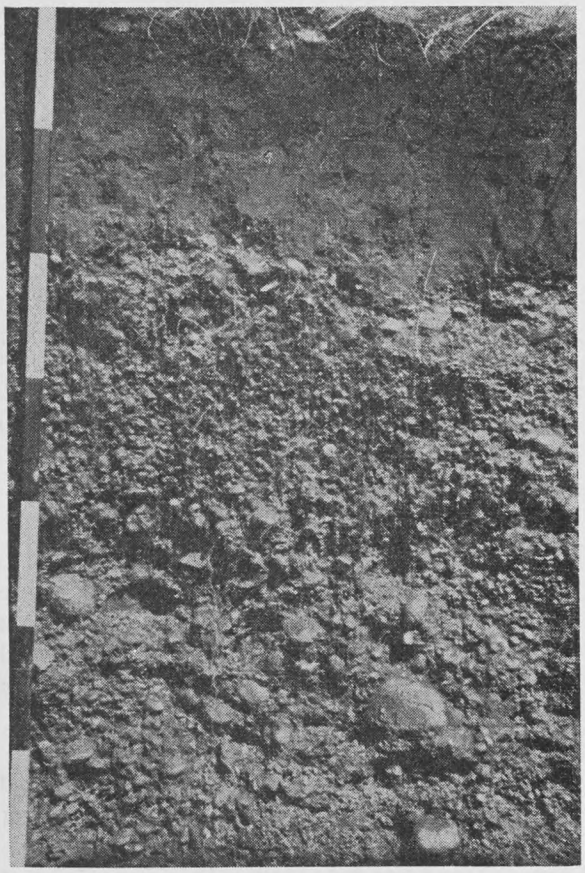


FIGURE 16

Soil profile of Marringhurst sandy loam. A Black soil developed on gravel outwash. (Measuring stick interval = 6 inches.)

A —3 to 7 inches, very dark grey loamy sand to coarse sand; weakly granular to structureless; very friable to loose; neutral to mildly alkaline.

AB—1 to 5 inches, very dark greyish brown loamy sand to coarse sand; weakly granular to structureless; very friable to loose; neutral to mildly alkaline.

B —3 to 5 inches, brown loamy sand to coarse sand; weakly subangular blocky to structureless; very friable to loose, slightly cemented when dry; mildly alkaline.

Cca—5 to 12 inches, light yellowish brown coarse sand and gravel; structureless; loose when moist, weakly cemented when dry; moderately alkaline and calcareous.

C —Yellowish brown, stratified sand and gravel; structureless; loose, mildly alkaline in reaction.

Associated Meadow soils occur in a few depressional sites.

Agriculture: The Marringhurst soils are low in natural fertility and have very low moisture-retention capacity. Small areas are cultivated but productivity is low. Wind erosion has been severe on cultivated soils, especially in dry years. These soils are best utilized for permanent pasture.

MINIOTA ASSOCIATION (2,396 acres)

The Miniota soils are developed on sandy and coarse sandy outwash deposits. These deposits become coarser with depth and a gravel substrate is of common occurrence. The surface texture varies from loamy sand to fine sandy loam.

The topography of the Miniota soils is level to slightly undulating. Soil drainage is good to

somewhat excessive as internal percolation is rapid. The native vegetation is largely mixed prairie grasses and associated herbs. Aspen occurs in local imperfectly drained sites.

The dominant soil is a Black which may be described as follows:

A —7 to 13 inches, very dark grey sandy loam; granular; very friable when moist; slightly hard when dry; neutral in reaction. Grades into:

B —8 to 14 inches, brown loamy sand; weakly subangular blocky to structureless; very friable when moist, slightly hard when dry; neutral to slightly acid in reaction.

Cca—4 to 6 inches, very pale brown loamy sand; finely granular to structureless; very friable to loose when moist, cemented when dry; moderately alkaline and calcareous.

C —Pale brown stratified coarse sand and gravel; structureless; loose, mildly alkaline and weakly calcareous.

Small areas of associated Black-Meadow soils occur at scattered locations.

Agriculture: The Miniota soils have low natural fertility. They contain only a moderate to low reserve of organic matter and moisture-holding capacity is low.

The Miniota soils may be used for grain production, but they are very susceptible to wind erosion. Measures, such as maintaining trash cover and the use of grasses and legumes in the rotation, are necessary to minimize the erosion hazards.

SOIL ASSOCIATIONS IN WHICH THE DOMINANT SOIL IS A BLACK-MEADOW

ARDEN ASSOCIATION (27,464 acres)

The Arden soils are developed on medium textured, reworked boulder till of limestone and granitic rock origin. In local areas a thin lacustrine mantle lies over the boulder till. Surface textures range from very fine sandy loam to clay loam. A stony and gravel lens occurs within the soil profile over a large section of the area. Surface stones are sufficiently numerous to interfere with and, in some places, to prevent cultivation.

The topography of the till plain is nearly level. Soil drainage is imperfect to poor, as surface runoff and internal drainage are slow. In wet years surface runoff accumulates in the numerous slight depressions which occur throughout the soil area. The native vegetation is meadow-prairie and meadow-grass associations intermixed with aspen and balsam poplar in groves of various sizes.

The Arden soils have been mapped as (i) Arden loams and (ii) Arden loams, gravel lens phase.

(i) *Arden loam* (14,999 acres)

The surface texture of the Arden loam soils varies from loam to clay loam. The dominant soil is a Calcareous Black-Meadow soil with the following profile features:

O —0 to 2 inches, black leaf mat; alkaline in reaction.

A —5 to 12 inches, very dark grey clay loam; granular; friable when moist, slightly hard when dry; moderately alkaline and weakly calcareous.

Cca—5 to 10 inches, light greyish brown clay loam; finely granular; friable when moist, slightly cemented when dry; moderately alkaline, strongly calcareous.

C —Pale brown, clay loam boulder till; pseudo-granular; firm when moist, cemented when dry; moderately alkaline, strongly calcareous; iron stained.

Associated soils include: Calcareous Meadow and Saline Meadow types. The salinized soils are limited in extent.

(ii) *Arden loam, gravel lens phase* (12,465 acres)

The surface texture of this soil ranges from very fine sandy loam to clay loam. Soil profiles with a gravel lens, which varies from a few to 20 or more inches in depth, are predominant in areas mapped as this soil phase. The representative soil is a Calcareous Black-Meadow which may be described as follows:

O —0 to 2 inches, black leaf mat; alkaline in reaction.

A —5 to 12 inches, very dark grey fine sandy clay loam; finely granular; friable when moist, slightly hard when dry; moderately alkaline, weakly calcareous.

Cca—6 to 15 inches, light greyish brown fine sandy loam to gravel and cobbles; very friable to loose, moderately alkaline and calcareous; weakly iron stained. The gravel lens may be all or only partly within the ca horizon.

D —Pale brown boulder till, pseudo-granular; friable when moist, cemented when dry; moderately alkaline, strongly calcareous; iron stained.

Associated soils include: Calcareous Meadow and limited areas of Saline Meadow soils.

Agriculture: The Arden soils have moderate to low natural fertility. They have a fair organic matter reserve and a fair water retention capacity, but free lime carbonate in the surface horizons decreases the availability of some plant nutrients.

The Arden soils are utilized primarily for grain production. Livestock are kept on farms with a large percentage of stony nonarable land. The principal soil problems are: the limited fertility caused by the high-lime content of surface horizons; the flooding of low areas in wet seasons due to the slow internal drainage and slow runoff; and stoniness which interferes with cultivation over most of the association area.

KELD ASSOCIATION (461 acres)

The Keld soils are developed on boulder till which is predominantly of acid shale origin. The till is underlain with soft, very strongly acid shale bedrock at two to more feet. The stones in the till are almost entirely of granitic origin as the limestones originally present have dissolved in the acid soil. Some granitic rocks also have disintegrated completely. Stones are widespread but are not a serious problem in cultivation. Surface texture is dominantly heavy clay loam but ranges from loam to clay.

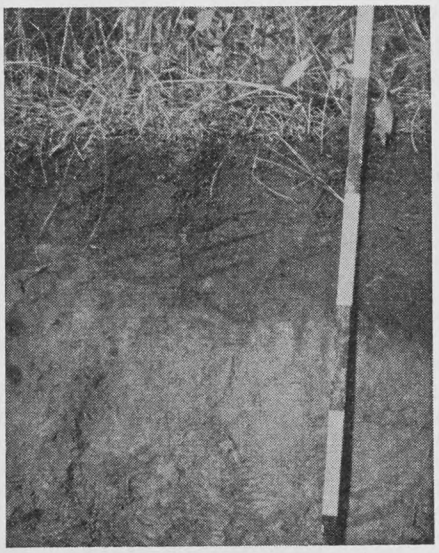


FIGURE 17
Soil profile of Keld heavy clay loam. An acid Black-Meadow soil developed on soft, acid shale till. (Measuring stick interval = 6 inches.)

The topography is smooth and level. The soils are dominantly imperfectly to poorly drained, as surface runoff and internal percolation are slow. The native vegetation on the imperfectly drained areas is mainly aspen, while on the poorly drained sites it is sedges and reeds with a few clumps of poplar.

The Keld soils on the imperfectly drained sites resemble a Meadow-like Black in morphological features and those on the poorly drained sites are like the various meadow soils common to the Black soil belt. Base saturation of the Meadow-like Black soil is 30 to 65 percent and in the Meadow soils the saturation is somewhat higher. Surface reaction varies due to the influence of lime-charged water occasionally received from surrounding areas with calcareous soils. Acidity in the shale bedrock however is fairly constant at a pH of 3.4. These soils do not fit into the present Canadian soil classification scheme but are placed with the Blacks on the basis of their appearance and on the presence of a dark colored A_1.

A generalized description of the Meadow-like Black soil is given below:

O —Very dark brown leaf and sod mat; pH 5.3 to 7.0.

A_1—8 to 12 inches, very dark greyish brown clay loam to clay; fine granular; slightly hard; pH 4.1 to 5.5.

B —10 to 16 inches, clay loam to clay mottled with yellowish red, reddish brown and yellowish brown colors; fine granular; soft; pH 3.9 to 4.4. Horizon is absent in some profiles.

C —10 to 16 inches, grey shale clay till mottled with yellow iron concretions; contains gypsum; pH 3.5-3.9; strongly gleyed. A coarser textured layer at the base of this horizon is common.

D —Grey shale clay; on the top of this horizon the shale is very soft and exists as clay but with depth the shale becomes harder. pH 3.4 to 3.5.

The Meadow type, described below, is dominant in the small area of Keld soils in the West-Lake area.

O —Thin layer of very dark brown muck; slightly acid.

A —6 to 9 inches, very dark greyish brown loam to clay; fine granular; soft, strongly acid; iron stained.

Cg—Olive brown clay loam to clay; sticky when wet, hard when dry; extremely acid; contains red and yellow concretions and gypsum crystals.

D—Grey shale clay; on the top of the horizon the shale is soft and exists as clay but with depth the shale becomes harder. pH 3.4 to 3.5.

Included in the Keld soil area are soils with a thin lacustral clay mantle over the acid shale clay. This mantle is mildly alkaline to slightly acid in reaction and is solonetzic. The lacustral clay is similar to that of the Dauphin association.

Other associated soils are the Peaty Meadow and Saline Meadow. These soils, with the exception of being acid, are similar to the poorly drained members in the Black associations. In general the surface mineral horizon is not as acid as that on the better drained soils.

Agriculture: The Keld soils are used mainly for mixed farming. Yields of grain are fair to poor. Much of the Keld soil area is in the virgin state due to imperfect drainage and to marginal productivity.

The main soil problems are excessive acidity and poor drainage. Greenhouse experiments at the University of Manitoba revealed that liberal application of lime were essential to substantially increase yields. In areas where acidity is less pronounced, increased yields have been reported by farmers using commercial fertilizers. For greater yields, it is indicated that both lime and fertilizers are required as well as a more adequate system of artificial drainage.

McCREARY ASSOCIATION (20,506 acres)

The McCreary soils are developed on thin, loam to clay loam lacustrine deposits which lie over reworked boulder till. Surface textures range from very fine sandy loam to clay loam. There are very few stones in the surface horizons.

The topography is smooth and level. Surface and internal drainage is slow. The subsoil in this area is periodically waterlogged and the soils are predominantly imperfectly and poorly drained. The native vegetation prior to clearing was dominantly aspen, balsam poplar and willow on imperfectly drained areas and balsam poplar, willow, reeds and sedges in poorly drained areas.

The dominant soils are Black-Meadow soils which have the following profile characteristics:

A —5 to 10 inches, very dark grey very fine sandy loam to clay loam; fine granular to granular; friable when moist, slightly hard when dry; mildly to moderately alkaline, may be very weakly calcareous.

Cca—5 to 10 inches, grey loamy fine sand to clay loam; finely granular; friable when moist, slightly cemented when dry; moderately alkaline, moderately calcareous.

C —Of variable depth, light yellowish brown to olive brown fine sand to clay loam; structureless to pseudo-granular; loose to friable when moist, weakly cemented when dry; moderately alkaline and moderately calcareous. This C horizon may be absent.

D—Greyish brown to light yellowish brown reworked till; pseudo-granular; friable when moist, slightly cemented when dry; moderately alkaline, moderately calcareous.

Associated soils in the poorly drained sites are predominantly Calcareous Meadow soils, although Saline Meadow soils occur at scattered locations.

Agriculture: The McCreary soils have fair to good natural fertility. They have a fair to good reserve of organic matter and a fair moisture holding capacity. However, over much of tne soil area the surface horizons contain considerable free lime carbonate which reduces the availability of the essential plant nutrients. In addition soil aeration is poor in wet seasons as surface runoff and internal drainage are slow.

The McCreary soils are suited to the production of grain crops in years of average or below average precipitation. In wet years grain

crops may be retarded by waterlogging and surface flooding of the soil. Artificial drains are useful in carrying away much of the free surface waters, but a large part of the waterlogging is caused by a high water table which is continually replenished through seepage from the alluvial fans and steep mountain slopes to the west. Soil areas which are particularly susceptible to flooding should be seeded to flood-tolerant grasses to provide for the more efficient utilization of the McCreary soils.

NORGATE ASSOCIATION (5,921 acres)

The Norgate soils are developed on thin, medium to fine textured lacustrine deposits which lie on a thin deposit of clay textured shaly till. This till lies over soft stratified shale. The surface texture varies from clay loam to clay. Stones occur throughout the soil area but prevent cultivation only in localized areas.

The topography is smooth, level to very gently sloping. Internal drainage is slow but surface drainage is good to fair and the soils are predominantly imperfectly drained rather than poorly drained. Although the soils were developed under grassland, the native vegetation by the time of settlement was dominantly aspen and balsam poplar along with associated species such as willow, red osier dogwood and snowberry.

The dominant Black-Meadow soil, which constitutes by far the largest portion of the association, has the following profile features:

A —6 to 11 inches, very dark grey clay loam to clay; granular; friable when moist, hard when dry; mildly alkaline, usually very weakly calcareous in the lower portion of the horizon.

Cca—3 to 9 inches, light grey to yellowish brown clay loam to clay; fine granular; friable when moist, slightly cemented when dry; moderately alkaline, moderately calcareous; weakly iron stained.

C —Very pale brown clay loam to clay shaly till; pseudo-granular; firm when moist, slightly cemented when dry; moderately alkaline, weakly calcareous; iron stained.

D —Dark grey to greyish brown, soft stratified shale; sticky when wet; iron stained.

Associated soils include minor areas of Degrading Black, Calcareous Meadow and Peaty Meadow types.

Agriculture: The Norgate soils produce good yields of regionally adapted crops. The soils have a fair to good supply of organic matter, a good moisture retention capacity and a soil reaction favorable to plant growth.

The Norgate soils are utilized predominantly for grain production, although small numbers of livestock are produced on some farms. The livestock utilize local areas which may be too stony or rough for cultivation. Stones are sufficiently numerous to be a hindrance during cultivation over most of the soil area. The agricultural productivity of the poorly drained areas could be improved by surface drainage.

KELWOOD ASSOCIATION (3,525 acres)

The Kelwood association of soils is developed on thin, medium-textured lacustrine deposits which lie over modified clay loam boulder till deposits containing a high percentage of shale. A thin gravel lens commonly occurs between the lacustrine deposit and the underlying till. Surface texture varies from very fine sandy loam to clay loam. Surface stones are sufficiently numerous to interfere with and, in local areas, to prevent cultivation.

The topography is smooth level. Surface runoff and internal drainage are slow, and consequently the soils are dominantly imperfectly and poorly drained. The native vegetation is predominantly aspen and balsam poplar woods on imperfectly drained sites and balsam poplar, willow, reeds and sedges on poorly drained sites.

The dominant soil is a Calcareous Black-Meadow soil which has the following profile features:

A—4 to 8 inches, very dark grey very fine sandy loam to clay loam; granular; firm when moist, hard when dry; moderately alkaline, very weakly calcareous.

Cca—5 to 12 inches, greyish brown fine sandy loam to clay loam; fine pseudo-granular; friable when moist, weakly cemented when dry; moderately alkaline, moderately calcareous; iron stained. A gravel lens commonly occurs within the ca horizon.

D—Dark greyish brown shaly boulder till; amorphous; plastic and very sticky when wet; moderately alkaline, moderately calcareous; contains concretionary iron and lime carbonate. (In some places this horizon may be shale in situ rather than till.)

Associated soils include: Calcareous Meadow, Saline Meadow and Peaty Meadow soils.

Agriculture: The Kelwood soils have moderate to low natural fertility. The organic matter reserve is limited and the free lime carbonate in the surface horizons reduces the availability of some essential plant nutrients. The widespread poor soil drainage and soil aeration tend to retard crop development, especially in wet years.

The arable Kelwood soils are utilized almost entirely for grain crops, while the nonarable poorly drained and stony soils are utilized by hay and stock grazing. The primary soil problem is the widespread poor soil drainage. Seepage and surface waters from the high land to the west periodically saturate the Kelwood soils during wet seasons. Construction of drainage ditches would help to alleviate this problem.

DAUPHIN ASSOCIATION (18,017 acres)

The Dauphin soils are developed on fine textured lacustrine deposits. In some areas a boulder till substrate is encountered within 30 inches from the surface. These areas were mapped as Dauphin till substrate phase. Surface texture is predominantly clay with local areas of heavy clay loam or silty clay soils. A few stones occur in the surface horizons of the till substrate phase soils.

The topography is nearly level. Internal drainage and surface runoff are slow, so that the soils are imperfectly and poorly drained. The vegetation under which the Dauphin soils developed was principally meadow and meadow-prairie grass associations. Trees border the stream channels and small aspen and willow groves occur at scattered locations on the level plain.

The Dauphin soils are described as: (i) Dauphin clay and (ii) Dauphin clay, till substrate phase.

(i) *Dauphin clay* (5,530 acres)

The imperfectly drained associate constitutes the largest portion of the Dauphin clay soils in the West-Lake area. The dominant Black-Meadow soil has the following profile features:

A—4 to 10 inches, very dark grey clay; finely granular; firm when moist, very hard when dry; moderately alkaline, very weakly calcareous. Grades into:

Cca—5 to 8 inches, dark grey to grey clay; fine pseudo-granular; plastic and sticky when wet, cemented when dry; moderately alkaline, moderately calcareous; iron stained, may contain gypsum crystals.

C—Olive grey clay; massive; very sticky and plastic when wet, very hard when dry; moderately alkaline, weakly calcareous; iron stained, may contain gypsum crystals.

Associated soils include: Peaty Meadow, Saline Meadow and Calcareous Meadow types. Most of the peat has been removed through fire and cultivation. The Saline Meadow and Calcareous Meadow soils are limited in extent. With improved drainage the soils tend to develop the prismatic structures common to solonetzic soils.

(ii) *Dauphin clay, till substrate phase* (12,488 acres)

This soil phase differs from the Dauphin clay by the presence of a till substrate within 30 inches of the surface. Surface textures tend to be slightly coarser than those of the Dauphin clay soils. The dominant soil is a Black-Meadow which has the following profile features:

A —6 to 14 inches, very dark grey clay to heavy clay loam; granular; friable to firm when moist, hard to very hard when dry; mildly alkaline, very weakly calcareous. Grades into:

Cca—10 to 15 inches, grey to dark grey clay loam to clay; pseudo-granular; very sticky and plastic when wet, cemented when dry; moderately alkaline, strongly calcareous; weakly iron stained. A thin, massive, olive grey C horizon may be present or the Cca horizon may grade sharply into:

D—Olive grey reworked boulder till of varying texture; moderately alkaline, strongly calcareous; strongly iron stained.

Associated soils include: Calcareous Meadow and Saline Meadow soils in depressional areas and Black-Meadow soils with weak solonetzic character on better drained sites.

Agriculture: The better drained Dauphin soils have good natural fertility. They have a fair to good supply of organic matter and good moisture-retention capacity. The poorly drained soils are less fertile as soil aeration and drainage is poor and the surface horizons contain an excess of free lime carbonate which affects the availability of soil phosphorus.

The Dauphin soils are utilized primarily for grain production. The main soil problems are widespread poor drainage and poor soil tilth. Surface drainage can be improved by clearing present ditches and installing shallow field drainage channels. Internal drainage can be improved through the use of legume and grass crops alone or in mixtures in the soil rotation. These practices while improving soil drainage also improve soil aeration and workability.

LAKELAND ASSOCIATION (184,205 acres)

The Lakeland association is developed on thin, medium to coarse textured lacustrine deposits. A till substrate phase is recognized where the underlying boulder till occurs within 30 inches of the surface. Surface textures in the association vary from fine sandy loam to silty clay. The degree of surface stoniness in areas of the till substrate phase soils varies with the thickness of the surface mantle over the underlying till. The surface is relatively stone-free where the mantle is thick, but surface stones are numerous where the mantle is thin.

The topography is nearly level. Surface runoff is slow and internal drainage is moderate to slow. Therefore almost the entire Lakeland area has imperfect to poor drainage. The native vegetation is meadow and meadow-prairie grasses along with small groves of aspen and balsam poplar on the imperfectly drained sites and meadow-grasses, reeds and sedges in poorly drained sites.

FIGURE 18

Cultivated Lakeland soils showing light-colored limy materials brought to the surface by tillage implements.

The Lakeland association has been divided into two textural types and a till substrate phase of each of these types as follows: (i) Lakeland loam, (ii) Lakeland loam, till substrate phase, (iii) Lakeland clay loam, (iv) Lakeland clay loam, till substrate phase.

(i) *Lakeland loam* (53,568 acres)

The surface texture of the Lakeland loam is predominantly very fine sandy loam but

varies from fine sandy loam to silt loam. The dominant Calcareous Black-Meadow soil has the following profile features:

A —4 to 9 inches, very dark grey very fine sandy loam; weakly fine granular; very friable when moist, soft when dry; moderately alkaline, weakly calcareous.

AC—1 to 9 inches, dark grey to olive grey very fine sandy loam; weakly fine granular; very friable when moist, slightly cemented when dry; moderately alkaline, moderately calcareous.

Cca—3 to 7 inches, greyish brown loamy very fine sand; fine pseudo-granular; very friable when moist, weakly cemented when dry; moderately alkaline, strongly calcareous; weakly iron stained.

C —Pale yellow very fine sand; laminated; loose; moderately alkaline, moderately calcareous; weakly iron stained.

Associated soils include: Calcareous Meadow, Peaty Meadow and localized areas of Saline Meadow soils. The Calcareous Meadow is the dominant poorly drained type. The peaty surface mantle has been removed from a large portion of the Peaty Meadow soils through cultivation and burning.

FIGURE 19

Soil profile of Lakeland clay loam. A Calcareous Black-Meadow soil developed on medium textured deltaic deposits. (Measuring stick interval = 6 inches.)

(ii) *Lakeland loam, till substrate phase* (17,073 acres)

This phase has been separated from the Lakeland loam soils on the presence or a till substrate within 30 inches of the soil surface. The soil textures are predominately very fine sandy loam but vary from fine sandy loam to silt loam.

Calcareous Black-Meadow soils constitute the largest portion of the phase. This soil has profile features similar to the modal Lakeland loam soils with the exception that the surface or A horizon is slightly thicker and a till substrate occurs within 30 inches of the surface. The same associated genetic types occur as listed for the Lakeland loam area.

(iii) *Lakeland clay loam* (59,535 acres)

The surface texture of the Lakeland clay loam is predominantly silty clay loam but varies from silt loam to silty clay. The dominant Calcareous Black-Meadow soil has the following profile features:

A —5 to 12 inches, very dark grey clay loam; finely granular; friable when moist, slightly hard when dry; moderately alkaline, weakly calcareous.

Cca—4 to 10 inches, light grey clay loam; fine pseudo-granular; sticky and plastic when wet, friable when moist, cemented when dry; moderately alkaline, strongly calcareous.

C —Yellowish brown clay loam; pseudo-granular to massive; friable when moist, cemented when dry; moderately alkaline, strongly calcareous; iron stained.

Associated soils include: Calcareous Meadow, Peaty Meadow and Saline Meadow soils. The Calcareous Meadow soils are the predominant poorly drained members. The Saline Meadow soils constitute a minor portion of the association. In many areas the peat covering has been destroyed by fire or by cultivation.

(iv) *Lakeland clay loam, till substrate phase* (54,029 acres)

This phase has been separated from the Lakeland clay loam on the presence of a till substrate within 30 inches of the surface. The surface textures are predominantly silty clay loam but vary from silt loam to silty clay.

Calcareous Black-Meadow soils are dominant in this phase. The profile features of these soils are similar to the profile features of the dominant soil described under Lakeland clay loam. However the surface or A horizon is usually slightly thicker and a till substrate occurs within 30 inches of the surface. The same associated genetic types occur as listed for the Lakeland clay loam area.

FIGURE 20

Soil profile of Lakeland clay loam, till substrate phase. A Calcareous Black-Meadow soil developed on medium textured deltaic deposits.

Agriculture: The Lakeland soils have moderate to low natural fertility. They have a fair reserve of organic matter and a moderate to low moisture-retention capacity. The free lime carbonate in the surface horizons combines with soil phosphorus and other essential plant elements thus limiting soil fertility. Soil aeration is poor in the finer textured soils in wet seasons. Locally, salinity is sufficient to inhibit crop growth.

The Lakeland soils are utilized largely for grain growing. Small herds of livestock are produced on farms containing or occurring adjacent to the stony Isafold soils which are nonarable but suitable for pasture. In grain growing the phosphate deficiency may be largely offset by the use of phosphate fertilizers. Phosphate deficiencies in cattle may be avoided by regular feeding of phosphate supplements such as bonemeal. An adequate artificial drainage system must be maintained to control surface flooding. Further, the improvement of soil drainage tends to reduce local salinity in imperfectly and poorly drained areas. Surface stoniness may interfere with soil tillage in areas of till substrate phase soils.

ALMASIPPI ASSOCIATION (103,910 acres)

The Almasippi soils are developed on coarse textured lacustrine deposits. These deposits are underlain by a finer textured substrate, usually at about ten feet below the surface. The surface texture ranges from sand to very fine sandy loam. A till substrate phase has been separated in areas where the underlying boulder till occurs at less than 30 inches from the soil surface.

The topography is level. The Almasippi soils have developed under varying degrees of imperfect drainage, as surface runoff is slow and internal drainage is impeded by the finer textured substrate. The native vegetation consists of tall-prairie grasses, meadow grasses and sedges interspersed with areas of aspen poplar, balsam poplar, willow and associated shrubs.

The Almasippi association in the West-Lake area has been divided into two textural types

and a till substrate phase of one of these types. These divisions are: (i) Almasippi loamy fine sand, (ii) Almasippi loamy fine sand, till substrate phase, and (iii) Almasippi fine sandy loam.

(i) *Almasippi loamy fine sand* (70,410 acres)

The Almasippi loamy sand soils are characteristically loamy fine sand in surface texture, but scattered areas occur with sand or fine sandy loam surface textures. A generalized description of the dominant Black-Meadow soil is given below.

A —6 to 12 inches, dark grey loamy fine sand; weakly fine granular; very friable when moist, soft when dry; mildly alkaline in reaction. Blends gradually into:

B —5 to 10 inches, dark greyish brown to greyish brown loamy fine sand to fine sand; structureless; loose to weakly cemented when dry; moderately alkaline, weakly calcareous. Grades sharply into:

Cca—12 to 16 inches, very pale brown fine sand; structureless; loose, weakly cemented when dry; moderately alkaline, moderately calcareous. Blends gradually with:

C —Very pale brown fine sand; structureless; loose; moderately alkaline, moderately calcareous; iron stained. May contain some gypsum.

Associate types include: Degrading Black-Meadow, Meadow, Peaty Meadow, Calcareous Meadow and Saline Meadow soils. The Degrading Black-Meadow soils occur on the broad low ridges which generally are coarser in texture and somewhat better drained. The poorly drained types, which occur in the broad depressions, are predominantly Meadow and Calcareous Meadow soils. In most places the surface texture of the poorly drained soils is finer than that of the Black-Meadow soils.

(ii) *Almasippi loamy fine sand, till substrate phase* (29,261 acres)

These soils are developed on less than 30 inches of coarse lacustrine deposits overlying boulder till. Surface texture is usually loamy fine sand, but varies from sand to fine sandy loam. Soil drainage is imperfect to poor as internal percolation is impeded by the boulder till substrate. The dominant Black-Meadow type has the following profile features:

A —6 to 12 inches, very dark grey loamy fine sand; weakly fine granular; very friable when moist, soft when dry; moderately alkaline, very weakly calcareous.

Cca—Very pale brown loamy fine sand of variable thickness; weakly fine granular; friable when moist, weakly cemented when dry; moderately alkaline, moderately calcareous; weakly iron stained.

C —Very pale brown fine sand of variable thickness; structureless; loose, moderately alkaline, moderately calcareous; iron stained.

D —Brownish yellow reworked boulder till; amorphous; plastic and sticky when wet, hard when dry; moderately alkaline, strongly calcareous; strongly iron stained.

Associated types include: Calcareous Meadow, Saline Meadow and Peaty Meadow soils. The Calcareous Meadow soil is the predominant poorly drained type. Surface textures of the poorly drained soils are usually slightly finer than that of adjacent Black-Meadow soils.

(iii) *Almasippi fine sandy loam* (4,239 acres)

The Almasippi fine sandy loam soils are dominantly fine sandy loam in texture but vary from loamy fine sand to very fine sandy loam. A generalized description of the dominant Black-Meadow soil is presented opposite Figure 21 on page 56.

Associated soils include: Calcareous Meadow, Peaty Meadow and Saline Meadow soils. The Calcareous Meadow is the predominant poorly drained type.

Agriculture: The Almasippi soils have low to moderate natural fertility as they have a low moisture-retention capacity, a limited supply of organic matter, and often have an excessive amount of free lime carbonate in the surface soil. In addition, they are susceptible to waterlogging in wet seasons and wind erosion in dry seasons.

The agricultural land-use of the Almasippi soils varies with texture and soil drainage. In general, the soils are suited to mixed farming

A —8 to 12 inches, very dark grey fine sandy loam; fine granular; friable when moist, slightly hard when dry; mildly alkaline, very weakly calcareous.

B —3 to 8 inches, dark greyish brown loamy fine sand, structureless, loose; moderately alkaline.

Cca—6 to 10 inches, very pale brown fine sandy loam to loamy fine sand; fine pseudo-granular; friable when moist, weakly cemented when dry; moderately alkaline, strongly calcareous; iron stained.

C —Very pale brown sand; structureless; loose, weakly cemented when dry; moderately alkaline, moderately calcareous; iron stained.

FIGURE 21

Soil profile of Almasippi fine sandy loam. A Black-Meadow soil developed on sandy deltaic deposits. (Measuring stick interval = 6 inches.)

with major emphasis on livestock. The sand to loamy fine sand Almasippi soils are best utilized for forage crops as they are very susceptible to wind erosion The loamy fine sand to fine sandy loam textured soils are suited to crop rotations which include one to two years of grasses and legumes in a four to five year rotation. Erosion control practices such as trash cover and field shelterbelts, shou ld be utilized to prevent further deterioration of this soil. The poorly drained soils are best suited to permanent hay or pasture, although cereal crops may be grown in dry years and where adequate drainage can be provided.

SOIL ASSOCIATION IN WHICH THE DOMINANT SOIL IS A CALCAREOUS MEADOW

WESTBOURNE ASSOCIATION (8,548 acres)

The Westbourne clay soils are developed on thin, fine textured lacustrine deposits overlying clay textured boulder till. The lacustrine mantle is usually less than two feet thick. The surface lacustrine material is nearly stone-free, but the underlying till contains many pebbles, cobbles and larger stones. A substrate of highly calcareous, clay loam boulder till usually occurs at depths of four to six feet.

FIGURE 22

Sparse flax growth on saline spots in Westbourne soils. Small area in foreground is strongly salinized.

The topography is level to depressional. Surface runoff is slow to very slow and internal drainage is very slow. Consequently the soils are mostly poorly drained. The vegetation consists of meadow grasses and herbs intermixed with clumps of willow and some aspen on the slightly better drained sites, and sedges in the very poorly drained sites. Salt-tolerant plants such as glasswort, seablite, salt grass, wild barley and gumweed are common in local sites throughout the soil area.

The dominant soil of the Westbourne association is a Calcareous Meadow soil which is usually slightly saline. A profile description of this soil is given below:

FIGURE 23

Soil profile of Westbourne clay. A Calcareous Meadow soil developed on fine textured till. (Measuring stick interval = 6 inches.)

O —0 to 5 inches, very dark grey muck; slightly alkaline and calcareous.

A —4 to 10 inches, very dark grey clay; fine granular; very plastic and sticky when wet, very hard when dry; moderately alkaline, weakly calcareous; moderately gleyed.

Cca—6 to 12 inches, light grey clay to silty clay; fine pseudo-granular; very sticky and plastic when wet, cemented when dry; moderately alkaline, strongly calcareous; iron stained; often contains gypsum crystals.

C —Light olive grey clay; fine pseudo-granular; very sticky and plastic when wet, hard when dry; low porosity; moderately alkaline and moderately calcareous; iron stained; usually contains gypsum crystals.

Associated soils include: Peaty Meadow, Saline Meadow, Solonchak and Black Solonetz soils. Solonetzic soils occur mainly in areas with improved drainage. Salinized and Peaty Meadow soils occur in local sites throughout the soil area.

Agriculture: The Westbourne soils are fair to poor in natural fertility. Their productivity is impaired by poor drainage and poor aeration, high calcium carbonate content, and the occurrence of soluble salts in toxic quantities. Tillage operations are hampered by poor soil tilth, frequent excessively wet conditions and local stoniness.

These soils are best suited for hay production and pasture. Fair yields of barley, flax and forage crops can be obtained from non-saline areas if flooding can be prevented. Legumes may be grown in areas which are not subject to flooding in the spring or after heavy summer rains.

SOIL ASSOCIATIONS IN WHICH THE DOMINANT SOIL IS A DEGRADING BLACK-MEADOW

ONANOLE ASSOCIATION (12,925 acres)

The Onanole soils are developed on medium to coarse textured lacustrine deposits wnich lie over boulder till. Surface textures vary from loamy sand to clay loam. A till substrate phase is recognized where the boulder till occurs within 30 inches of the surface. A few surface stones occur in the till substrate phase areas.

The topography of the Onanole soils varies from smooth very gently sloping to irregular gently sloping, but the majority of these soils in the West-Lake area have relatively smooth topography. Soil drainage conditions vary according to the proximity of the underlying till to the surface and the location of the soil area in the landscape. Well-drained soils occur on hills and elevated plains but large areas of imperfectly and poorly drained soils occur in areas with flat topography which receive seepage waters from adjacent morainic hills. Although the Onanole soils were developed under grassland vegetation, the present vegetative cover on virgin sites is dominantly aspen woods with a thick undergrowth of shrubs such as hazel, wild rose and saskatoon. The poorly drained soils may be covered by black poplar-willow woods or meadow grasses, reeds and sedges.

The Onanole association has been divided into two textural types and a till substrate phase of one of these types as follows: (i) Onanole sandy loam, (ii) Onanole clay loam, and (iii) Onanole clay loam, till substrate phase.

(i) *Onanole sandy loam* (2,419 acres)

The surface texture of these soils varies from loamy sand to fine sandy loam but is characteristically loamy fine sand The dominant soil is a Degrading Black-Meadow which may be described as follows:

O —1 to 3 inches, very dark greyish brown leaf mat, neutral in reaction.

A —8 to 12 inches, dark greyish brown loamy fine sand, weakly granular; very friable when moist, soft when dry; neutral to slightly alkaline in reaction. Grades into:

B —6 to 10 inches, brown to pale brown loamy fine sand, weakly granular; very friable when moist, slightly hard when dry; neutral to slightly alkaline, weakly iron stained in lower portion of the horizon. Grades into:

C —Very pale brown fine sand; structureless; loose when moist, weakly cemented when dry; moderately calcareous, moderately alkaline; iron stained.

Associated soils include: Dark Grey Wooded, Meadow and Peaty Meadow soils. The Dark Grey Wooded soils occur on the better-drained sites. The surface horizons in the poorly drained soils tend to be finer than those of the better-drained soils. Where the peaty mantle in the poorly drained areas exceeds 12 inches in thickness, the soils are classified as Half Bog and Bog soils.

(ii) *Onanole clay loam* (7,004 acres)

The surface texture of this soil varies from very fine sandy loam to clay loam. Within the West-Lake area the dominant soil of this type is a Degrading Black-Meadow soil. A generalized description of this member developed on very fine sandy clay loam parent material is given below:

O —1 to 2 inch leaf mat, neutral in reaction.

A —3 to 6 inches, very dark grey very fine sandy clay loam; granular; friable when moist, slightly hard when dry; neutral in reaction.

B —3 to 7 inches, greyish brown very fine sandy clay loam; granular; friable when moist, hard when dry; neutral to mildly alkaline in reaction.

Cca—6 to 10 inches light yellowish brown very fine sandy clay loam; fine pseudo-granular; very friable when moist, weakly cemented when dry; moderately alkaline, strongly calcareous; weakly iron stained.

C —Yellowish brown to pale yellow very fine sandy clay loam; pseudo-granular; friable when moist, hard when dry; moderately alkaline, strongly calcareous; weakly iron stained.

Associated soils include: Dark Grey Wooded, Meadow and Peaty Meadow soils. Where the peat covering in the poorly drained areas exceeds 12 inches in thickness, the soils are classified as Half Bog or Bog soils.

(iii) *Onanole clay loam, till-substrate phase* (3,548 acres)

This soil phase is separated on the basis of the occurrence of a till substrate within 30 inches of the soil surface. Surface texture varies from fine sandy loam to clay loam. Occasional stones are encountered on the soil surface.

The topography conforms closely to the undulations of the underlying till plain and may be described broadly as irregular very gently sloping. Soil drainage depends on the location of the soil with relationship to the surrounding landscape. Generally soil drainage is imperfect as internal drainage is impeded and surface runoff is dominantly moderately slow.

The soils are predominantly of the Degrading Black-Meadow type. The soil profile closely resembles that described for the Onanole clay loam soils with the exception that a till substrate occurs within 30 inches from the surface. Associated soils include Dark Grey Wooded, Meadow and Peaty Meadow types.

Agriculture: The Onanole soils have medium to low natural fertility. The medium textured type is superior to the coarse textured type for most agricultural crops. The medium textured type has a fair to good moisture-retention capacity, a fair reserve of organic matter and a soil reaction favorable to plant growth. The coarser textured type has limited moisture retention capacity and organic matter reserve.

Mixed farming is the predominant enterprise on the Onanole soils. Most of the arable land is cropped in a fallow-grain rotation and nonarable areas are utilized for hay and pasture. There has been considerable loss of fertility through this land-use system. Grass and legume crops are well suited to this soil area and should be included in the crop rotation as they protect the soil against erosion and provide a reliable supply of high quality hay and pasture for livestock.

SOIL ASSOCIATIONS IN WHICH THE DOMINANT SOIL IS A DARK GREY WOODED

ERICKSON ASSOCIATION (44,029 acres)

The Erickson association of soils has been developed on medium textured boulder till of mixed shale, limestone and granitic rock origin. The surface texture varies from loam to clay loam. With the exception of local areas, surface stones are not sufficiently numerous to seriously interfere with cultivation.

FIGURE 24

Landscape of Erickson soil area showing light-colored depressions containing Imperfectly Drained Grey Wooded soils.

The topography of the till plain is irregular with gentle to moderate slopes. Meadows, sloughs or shallow lakes occur in the enclosed depressions. The soil drainage of the slopes and knolls is good as surface runoff is rapid. The vegetation of the better drained soils is dominantly aspen with a thick undergrowth of hazel.

The dominant Dark Grey Wooded soil is well-drained and occurs on the slopes and crests of knolls in the till plain. A generalized description of the representative profile of this associate is given below:

O —1 to 3 inches, very dark brown leaf and sod mat; neutral in reaction.

A —5 to 8 inches, dark grey loam to clay loam; granular; friable when moist, slightly hard when dry; neutral to slightly acid in reaction. This horizon often may be divided into a very dark grey A_1 and a greyish A_2 horizon.

B_2—6 to 10 inches, dark greyish brown clay loam to heavy clay loam; subangular blocky; firm when moist, hard when dry; neutral to slightly acid in reaction.

B_3—2 to 4 inches, greyish brown clay loam; subangular blocky; firm when moist, hard when dry; neutral to mildly alkaline in reaction. Very weakly calcareous in lower portion of horizon.

Cca—8 to 12 inches, very pale brown clay loam; pseudo-granular; friable when moist, weakly cemented when dry; moderately alkaline, strongly calcareous. Grades into:

C —Light greyish brown clay loam boulder till of mixed limestone, shale and granitic rock origin; pseudo-fragmental; plastic when wet, hard when dry; moderately alkaline and moderately calcareous.

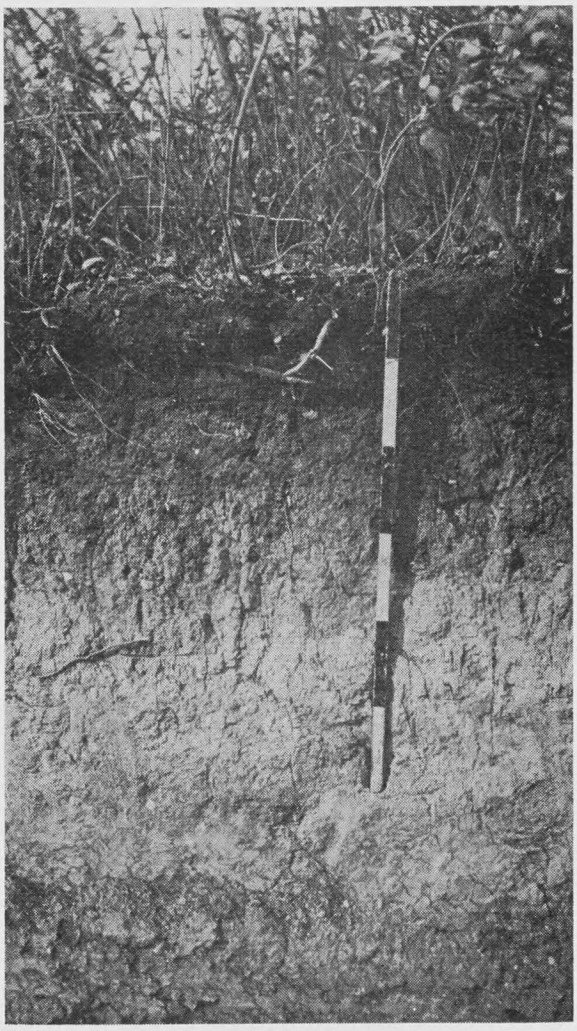


FIGURE 25

Soil profile of Erickson clay loam. A Dark Grey Wooded soil developed on moderately calcareous till. (Measuring stick interval = 6 inches.)

Associated types include: Degrading Black-Meadow, Imperfectly Drained Grey Wooded, Peaty Meadow, Degraded Meadow and Grey Wooded Gley soils. As the Erickson association occurs in a grassland to forest transitional area, varying degrees of woodland degradation can be expected. Grey Wooded soils of the Waitville association occur in local areas with dense forest vegetation; whereas Black soils of the Newdale association occur on grass covered south-facing knolls. Peaty Meadow soils are the most common type in the depressions. Some Bog and Half Bog soils occur in the very poorly drained areas.

Agriculture: The better-drained Erickson soils are naturally fertile as they have a good moisture retention capacity, a moderately good reserve of organic matter, and a neutral soil reaction which provides a good medium for plant nutrition.

The arable portion of the Erickson soils are utilized almost entirely for grain production. This land-use has resulted in severe water

erosion on many of the steeper slopes. Occurrence of erosion is indicated by the greyish brown colors on the slopes and knolls in the summerfallow fields and by the occurrence of shoe-string gullies. Grass and legume mixtures in the crop rotation, along with seeding down of steep slopes and runways to permanent grass cover, the ploughing down of sweet clover and preservation of trash cover in the fallow year are useful methods in combating erosion.

QUERCUS ASSOCIATION (1,267 acres)

The Quercus clay loam soils are developed on medium to fine textured boulder till deposits of dominantly shale origin. Surface stoniness is moderate to severe and many stones must be removed before cultivation is practical.

These soils are located along the east slope of Riding Mountain on a gentle fall to the east. The soil areas are dissected by the many deeply eroded channels which carry surface runoff from the mountain. Surface runoff is fair to good and although internal drainage is slow most of the soils have moderate to good drainage. The vegetation is predominantly oak, mixed with a few aspen and an undergrowth of hazel.

The dominant soil is a Dark Grey Wooded with the following profile features:

O —1 to 2 inches, leaf mat; slightly acid.

A_1—3 to 4 inches, very dark grey clay loam; finely granular; very friable when moist, soft when dry; neutral in reaction.

A_2—2 to 5 inches, dark grey to grey brown clay loam; granular; friable to firm when moist, slightly hard when dry; neutral to slightly acid in reaction.

A_3—2 to 4 inches, greyish brown heavy clay loam; medium subangular blocky; firm when moist, hard when dry; slightly acid in reaction.

B_1—3 to 5 inches, dark greyish brown heavy clay loam; subangular blocky; firm when moist, hard when dry; slightly acid in reaction.

B_2—5 to 9 inches, dark greyish brown heavy clay loam; coarse blocky; very firm when moist, very hard when dry; slightly acid in reaction.

B_3—7 to 12 inches, dark brown or olive brown heavy clay loam; coarse blocky; firm when moist, hard when dry; neutral in reaction.

Cca—5 to 15 inches, yellowish brown heavy clay loam; pseudo-fragmental to pseudo-granular; firm when moist; cemented when dry; moderately alkaline and calcareous; contains iron-stone concretions.

C —Greyish brown heavy clay loam boulder till; very firm and dense; moderately calcareous; contains many iron-stone concretions.

Associated soils include: Degrading Black-Meadow and minor areas of Meadow soils.

Agriculture: The Quercus soils are naturally fertile. Although organic matter reserve is low in the surface horizons, they have a soil reaction favorable to plant growth, a good moisture holding capacity and deeply developed soil profiles.

These soils are utilized for mixed farming. Clearing and breaking costs are high as numerous stones must be removed and the thick oak vegetation is costly to clear. Local areas are flooded occasionally by waters from the higher land to the west. Good yields of cereal crops are obtained and the soils are well suited to grass and legume crops. Large continuous fields cannot be farmed as the soil area is dissected by deep ravines.

MEADOWBROOK ASSOCIATION (10,345 acres)

The Meadowbrook soils are developed on fine textured boulder till which is predominantly of shale origin. Surface textures range from heavy clay loam to clay. A few surface stones occur but they are not sufficiently numerous to seriously interfere with cultivation.

The topography of this association is irregular gently sloping. The till plain is marked by numerous hills and small depressional areas. The soils on the gentle slopes and hills are moderately well to well-drained, but the soils in the depressions are poorly drained as surface runoff and internal drainage are slow. The native vegetation has been altered by fires and forestry operations, and large areas have been cleared for farming. The vegetation remaining on non-cleared sites is mainly aspen with an undergrowth of hazel.

The dominant soil is a solonetzic Dark Grey Wooded which may be described as follows:

O —1 to 2 inches, very dark brown leaf mat.
A_1—1 to 2 inches, very dark grey heavy clay loam; finely granular; friable when moist, soft when dry; slightly acid in reaction.
A_2—2 to 4 inches, dark grey to grey heavy clay loam; granular to platy; firm when moist, hard when dry; slightly acid in reaction.
B_1—3 to 5 inches, dark grey to greyish brown clay; prismatic; very firm when moist, very hard when dry; slightly acid to medium acid in reaction.
B_2—5 to 8 inches, very dark grey clay; prismatic; very firm when moist, very hard when dry; acid in reaction.
B_3—8 to 15 inches, dark grey to dark greyish brown clay; coarse blocky; very firm when moist, very hard when dry; neutral to slightly acid in reaction.
Cca—Diffuse layer of lime carbonate accumulation. Dark grey brown clay; pseudo-subangular blocky to pseudo-fragmental; firm when moist, hard when dry; moderately calcareous, moderately alkaline.
C —Very dark greyish brown to olive brown clay boulder till; massive; very plastic and sticky when wet, hard when dry; weakly calcareous, moderately alkaline.

FIGURE 26
Soil profile of Meadowbrook clay. A solonetzic Dark Grey Wooded soil developed on shale clay till. (Measuring stick interval = 6 inches.)

Associated soils include: Meadow, Peaty Meadow, and Degrading Black-Meadow soils. The soils in the depressions often are developed on thin alluvial clay deposits which lie over the boulder till.

Agriculture: The Meadowbrook soils have fair to good natural fertility. The soils have good moisture-retention capacity, a soil reaction favorable to plant growth, and good soil drainage. However, organic reserve is low and the soils have poor soil structure and are difficult to till.

The Meadowbrook soils are utilized for grain production and to a limited extent for livestock production. Cultivated fields are often irregular in shape as poorly drained areas are not suited to cultivation. Cultivated slopes in this area are very susceptible to water erosion as internal percolation is poor and therefore the largest percentage of the heavy rainfall must drain away in the form of surface runoff. Excellent stands of grass and legume crops can be grown. These crops should be included in the crop rotation as they improve the soil tilth, reduce soil erosion and the legume crops add appreciable quantities of readily available nitrogen to the soil.

LEARY ASSOCIATION (12,695 acres)

The Leary soils are developed on a very thin deposit of sand over coarse sand and gravel that is dominantly of limestone and granitic rock origin. Surface textures vary from sand to fine sandy loam. In some places a sand or a boulder till substrate occurs within three to four feet of the soil surface and in these areas a sand substrate or a till substrate phase of the association was mapped.

The topography varies from the rounded form of beach ridges to the nearly level topography of gravel plains. Surface runoff is of little importance as precipitation readily percolates through the coarse deposits. This percolation of water is very rapid, except in areas which have arrested internal drainage due to the impervious nature of the boulder till substrate. The native vegetation is dominantly aspen and oak woods. The oak are most

common on the apex of the beach ridges, whereas the aspen tend to dominate on the slopes of the beach ridges and on the gravel plains.

The Leary soils have been divided into: (i) Leary loamy sand, (ii) Leary loamy sand, till substrate phase and (iii) Leary loamy sand, sand substrate phase.

(i) *Leary loamy sand* (8,594 acres)

The dominant soil in the Leary loamy sand is a weakly developed Dark Grey Wooded which has the following profile features:

A —4 to 8 inches, very dark grey to dark grey loamy sand; weakly granular to structureless; friable to loose; neutral or slightly acid in reaction. This horizon often may be divided into a very dark grey A_1 horizon and a greyish A_2 horizon.

B —3 to 6 inches, brown loamy sand to gravel; weakly subangular blocky to structureless; friable to loose; neutral to mildly alkaline in reaction.

C —Stratified sand and gravel; structureless; loose; moderately alkaline. Gravel principally of limestone and granitic rock origin. A weak lime carbonate accumulation may be distinguishable below the "B" horizon.

Associated soils include: Degrading Black-Meadow and Meadow types. These types constitute only a minor percentage of the total soil area.

(ii) *Leary loamy sand, till-substrate phase* (1,221 acres)

The predominant soil type in this phase is a Dark Grey Wooded soil with similar profile characteristics as indicated for the Leary loamy sand soils, with the exception that a till substrate occurs below the gravel at two to three feet from the soil surface. This phase commonly occurs in gravel plains lying adjacent to the rounded gravel beaches. Associated soils include Degrading Black-Meadow, Meadow and Calcareous Meadow types.

(iii) *Leary loamy sand, sand-substrate phase* (2,880 acres)

The predominant soil type in this phase is a Dark Grey Wooded which is usually more strongly degraded than the Leary loamy sand soils. These soils usually have a thicker deposit of sand over the gravel and in some cases the "A" and "B" horizons are developed entirely within the sand layer. A sand substrate occurs at two to three feet below the soil surface. This soil phase occurs most commonly in gravel plains adjacent to the rounded gravel beaches. Associated soils include Degrading Black-Meadow, Meadow, and Calcareous Meadow types.

Agriculture: The Leary soils have very low natural fertility. They have a very limited organic reserve and low moisture-retention capacity. In addition, these structureless and loose soils are susceptible to wind erosion when cultivated.

The soils are used predominantly for pasture although livestock-carrying capacity is low. A few areas are cultivated but very poor crop yields are obtained in any year with a few weeks of dry weather. The soil, if cultivated, is best suited to fall rye as soil drainage is good and the rye crop prevents winter and spring erosion. The gravel ridges are a good source of material for road building.

SEECH ASSOCIATION (5,484 acres)

The Seech soils are developed on coarse sand and gravel deposits of shale, limestone, and granitic rock origin. Surface texture of the soil varies from sand to fine sandy loam, but loamy sand textured soils are dominant. The soil surface in some areas is cobbly but generally the soils are free of large stones.

The topography is irregular, very gently sloping to steeply sloping. Soil drainage is somewhat excessive as internal drainage is very rapid. The vegetation is aspen groves interspersed with tall prairie-grasses and with an admixture of shrubs such as wood rose, choke cherry and woody cinquefoil.

The genetic soil type varies with landscape position. The dominant type is a Dark Grey Wooded soil which has the following profile features:

A —4 to 7 inches, dark grey loamy sand, weakly granular; very friable when moist, soft when dry; neutral to slightly acid in reaction. In many cases this horizon is divided into a very dark grey A_1 horizon and a greyish A_2 horizon.

B —6 to 8 inches, dark greyish brown to brown loamy sand to coarse sand; granular to structureless; very friable to loose; neutral in reaction.

Cca—2 to 8 inches, light grey to greyish brown sand and gravel; structureless; loose when moist, weakly cemented when dry; moderately alkaline and calcareous.

C —Pale brown to greyish brown sand and gravel; structureless; loose; moderately alkaline and weakly calcareous.

Some Degrading Black and Black soils occur on knolls under prairie-grass vegetation. Imperfectly and poorly drained soils are very limited in area. Half Bog and Bog soils occur in very poorly drained depressions.

Agriculture: The Seech soils are low in fertility. They have a limited organic reserve and are very droughty as internal drainage is very rapid and moisture-retention capacity is low. Under cultivation they are very susceptible to wind erosion as the soil granules readily pulverize to loose, single grained particles.

The Seech soils in the West-Lake area are utilized almost entirely for pasture and wildlife. This form of land utilization is ideal.

BIRNIE ASSOCIATION (2,811 acres)

The Birnie soils are developed on coarse gravelly outwash fan deposits which are predominately of shale origin. The surface texture varies from fine sandy loam to clay loam. Surface stones and cobbles are numerous in the coarser portion of the outwash fans adjacent to the stream channels.

The topography is smooth, very gently sloping over most of the soil area. The soils are well to excessively drained as internal percolation through the shale is very rapid. The vegetation is dominantly scrubby bur oak and hazel with an admixture of shrub-like woody perennials such as wild rose, chokecherry and pincherry.

The Dark Grey Wooded type, which is the dominant soil, has the following profile characteristics:

A —8 to 11 inches, dark grey loam; granular; friable when moist, hard when dry; slightly acid in reaction. May be sub-divided into a very dark grey A_1 horizon and a grey A_2 horizon.

B —8 to 15 inches, dark greyish brown shaly loam to shale gravel; fragmental to structureless; friable to loose when moist; hard to loose when dry; slightly acid to neutral in reaction.

Cca—Greyish brown calcareous sand and shale gravel of variable depth; pseudo-fragmental to structureless; friable to loose; mildly alkaline in reaction, slightly calcareous. This horizon is very diffuse.

C —Greyish brown shaly sand and gravel; structureless; loose; mildly alkaline, slightly calcareous.

Degrading Black soils are associated with the dominant type. Areas of these soils are intermixed with the Dark Grey Wooded soils and much variation in the degree of leaching may occur in the same field.

Agriculture: The Birnie soils have low natural fertility. The moisture-retention capacity of the surface soil is fair but the subsoils are coarse and unretentive. Organic matter reserve is low and under cultivation the soil aggregates pulverize and are readily eroded by wind.

The Birnie soils are utilized for mixed farming. Fair grain crops are produced but the soils are marginal for this type of land-use. Cattle may be produced on these soils but the cost of clearing the native bush is high and the carrying-capacity of the soils is relatively low.

SOIL ASSOCIATIONS IN WHICH THE DOMINANT SOIL IS AN IMPERFECTLY DRAINED DARK GREY WOODED

SELINA ASSOCIATION (48,522 acres)

The Selina association of soils is developed on coarse textured lacustrine deposits, which are underlain by boulder till. A till substrate phase of the association was recognized in areas in which the boulder till substrate is encountered within 15 to 30 inches of the soil

surface. Few surface stones are encountered where the lacustrine mantle is thick but they are sufficiently numerous to interfere with cultivation in areas in which the lacustrine mantle is thin. Surface textures vary from sand to loamy fine sand.

The topography is nearly level, except for a few sandy beach ridges which traverse the area from south to north. Although internal percolation is rapid, soil drainage is imperfect as the underlying till impedes internal drainage. The native vegetation is predominantly aspen, balsam poplar and willow. Jack pine occur on better-drained ridges, while reeds, sedges, swamp birch and willow are the dominant vegetation in poorly drained sites.

The Selina soils have been divided into: (i) Selina sand and (ii) Selina sand, till substrate phase.

(i) *Selina sand* (34,007 acres)

The dominant member of the Selina sand soil is an Imperfectly Drained Dark Grey Wooded soil which is described as follows:

O —1 to 2 inch leaf mat; neutral in reaction.

A_1—1 to 2 inches, very dark grey loamy sand; weakly fine granular to structureless; very friable to loose, neutral in reaction.

A_2—2 to 7 inches, grey to greyish brown sand; structureless; loose, neutral in reaction; may be weakly iron stained.

B —4 to 10 inches, greyish brown sand; structureless; loose; neutral in reaction; weakly iron stained.

Cg—Greyish brown to light olive sand; structureless; loose; slightly calcareous; mildly alkaline; strongly iron stained.

C —Pale yellow to light grey sand; structureless; loose; slightly calcareous, mildly alkaline; iron stained.

Associated soils include: Grey Wooded, Meadow, Peaty Meadow and Calcareous Meadow soils. The poorly drained members usually have slightly finer textures than the imperfectly drained soils. The Grey Wooded soils occur on the sandy beach ridges.

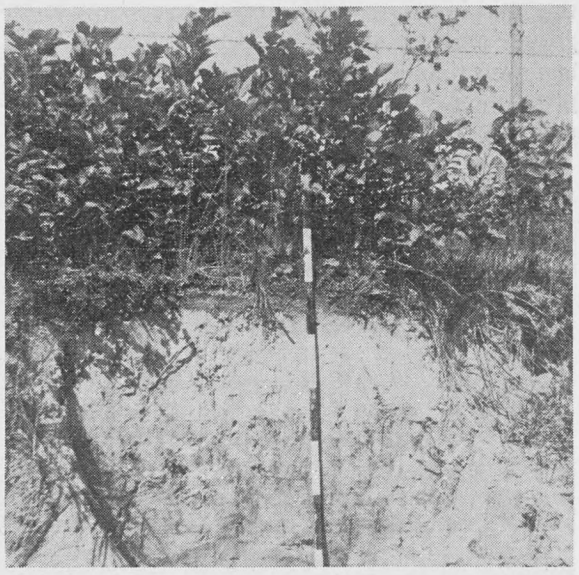


FIGURE 27

Soil profile of Selina sand. A Grey Wooded soil developed on a sand ridge. (Measuring stick interval = 6 inches.)

(ii) *Selina sand, till substrate phase* (14,515 acres)

This soil phase is separated from the Selina sand on the basis of a till substrate at a depth of 15 to 30 inches from the soil surface. The soil profile of the imperfectly drained member is similar to that of the Selina sand soils with the exception that the solum (A and B horizons) of the soil profile is thinner and the boulder till substrate occurs as a D horizon. In addition, the soils are slightly finer in texture. Associated soils include Meadow, Peaty Meadow and Calcareous Meadow members.

Agriculture: The Selina soils have low to very low natural fertility. Moisture-retention capacity is low and the soils contain a very low reserve of organic matter. The single-grained soil structure predisposes soils under cultivation to wind erosion.

The Selina soils are suited to livestock production and limited grain production. Much of the land is submarginal and good crops can be grown only at selected locations. Grass and legume mixtures grow well and supply needed fibre and soil nitrogen to the soil. Livestock farming and the use of forage crops at least three years out of six in the crop rotation is recommended on these soils.

SOIL ASSOCIATIONS IN WHICH THE DOMINANT SOIL IS A GREY WOODED

WAITVILLE ASSOCIATION (36,795 acres)

The Waitville loam to clay loam soils are developed on boulder till of mixed limestone, shale and granitic rock origin. This parent material is similar in composition to that on which the Newdale and Erickson soils are developed. Some stoniness occurs but the stones do not seriously affect land utilization.

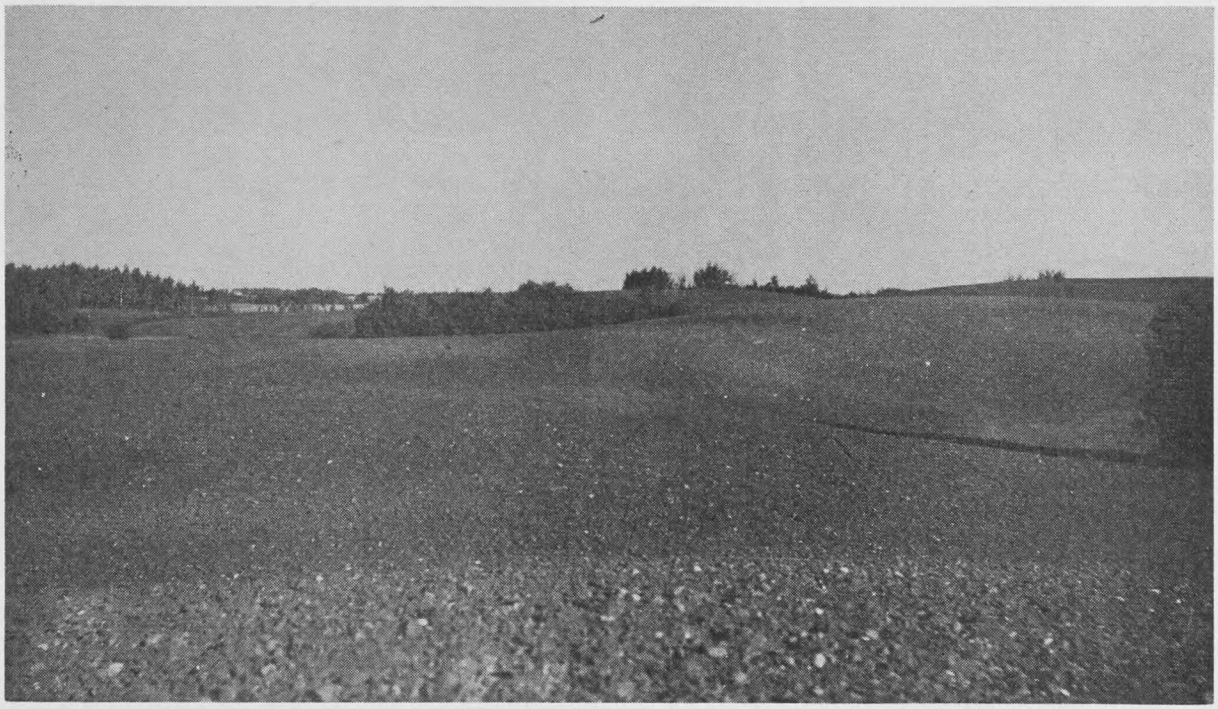


FIGURE 28

Landscape of Waitville soil area showing moderately sloping topography and light-colored top soil.

The topography is irregular, moderately sloping to hilly. The slopes and hills are well-drained but the numerous depressions in this irregular topography are occupied by shallow lakes, sloughs, meadows or spruce and tamarack bogs. On the slopes and knolls the vegetation consists of mixed woods. Aspen predominates, but it is intermixed with white spruce, some white birch and an undergrowth of hazel, wood rose, cranberry, etc.

The Grey Wooded soil type is predominant in the association. A modal well-drained Waitville soil has the following profile features:

O —1 to 3 inches of leaf mat, slightly acid in reaction.

A_1—0 to 1 inch, very dark grey mucky loam; finely granular; friable when moist, soft when dry; neutral to slightly acid in reaction.

A_2—2 to 4 inches, pale brown sandy loam to loam; weakly developed platy structure; firm when moist, slightly hard when dry; slightly acid in reaction. Coarse rock fragments are largely decomposed.

B_1—2 to 4 inches, brown clay loam; fine to medium subangular blocky aggregates; firm when moist, hard when dry; slightly acid in reaction.

B_2—4 to 6 inches, dark brown heavy clay loam; medium blocky aggregates are coated with clay skins; very firm when moist, very hard when dry; slightly acid in reaction.

B_3—3 to 5 inches, brown clay loam; medium blocky; firm when moist, hard when dry; neutral to mildly alkaline, weakly calcareous in lower portion of horizon. Grades sharply into:

Cca—Light grey clay loam of variable thickness; pseudo-granular; friable when moist, weakly cemented when dry; moderately alkaline, strongly calcareous; contains some powdered iron concretions. Fades into:

C —Light greyish brown, clay loam boulder till; pseudo-fragmental; very firm when moist, very hard when dry; moderately alkaline, moderately calcareous; contains some powdered iron concretions.

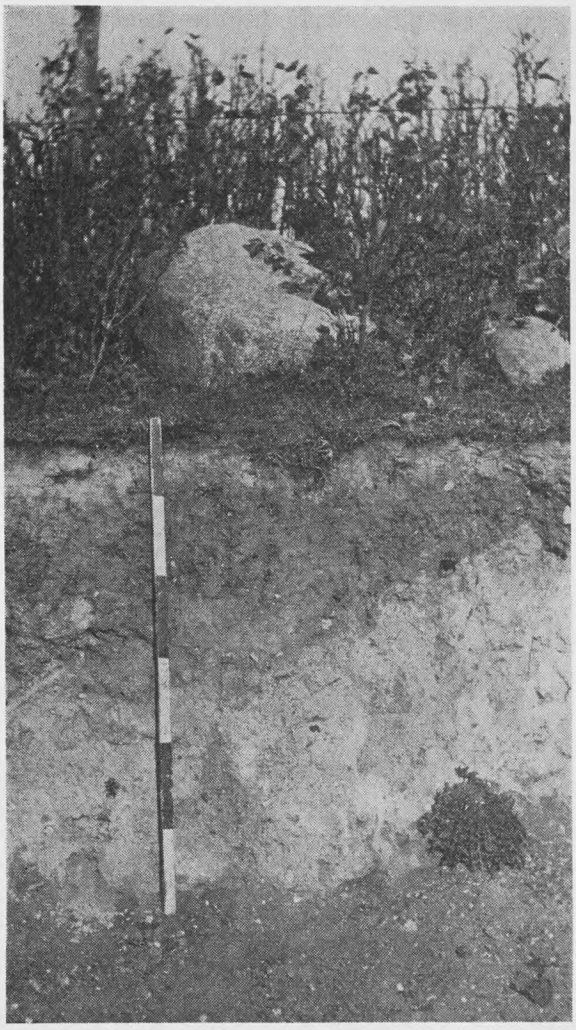


FIGURE 29

Soil profile of Waitville loam. A Grey Wooded soil developed on moderately calcareous till. (Measuring stick interval = 6 inches.)

These soils are associated in the landscape with Imperfectly Drained Grey Wooded, Peaty Meadow, Degraded Meadow and Grey Wooded Gley soils. The very poorly drained areas are usually occupied by Half-Bog and Bog soils.

Agriculture: The Grey Wooded Waitville soils have a moderate degree of natural fertility. They have a moderate moisture-holding capacity and a soil reaction favorable to crop growth. However, the organic reserve is low and the soils are responsive to nitrogen fertilization. The most important factor affecting their land-use is the irregular topography and steep slopes which contribute to a serious problem of soil erosion by water.

The Waitville soils are suited to mixed farming enterprises with major emphasis on livestock production. The steeper slopes are adaptable only to forage crop production. Steep slopes under native woods should not be cleared.

A crop rotation which includes two to three years of a grass-legume crop will return fibre to the soil. The legume crop supplies nitrogen to the succeeding cereal crops. With proper management, soil erosion can be controlled and good yields can be obtained. An additional hazard in this soil area is the aperiodic occurrence of late spring or early fall frosts.

GRANVILLE ASSOCIATION (31,427 acres)

The Granville very fine sandy loam to clay loam soils are developed on boulder till of mixed limestone, shale and granitic rock origin. The parent material of these soils is higher in shale content and slightly lower in lime carbonate content than that on which the Waitville soils are developed. Some stoniness occurs

FIGURE 30

Moderately sloping topography characteristic of the Granville soil association area.

but surface stones are not sufficiently numerous to interfere with cultivation.

The topography is irregular, gently to steeply sloping. The knolls and slopes are well-drained, but the numerous depressions are occupied by small lakes, sloughs, meadows or peaty organic deposits. The vegetation on the well-drained soils is aspen and white spruce with an undergrowth of hazel, wild rose and allied shrub-like species. The vegetation on poorly drained areas may be willow, reeds and sedges, or spruce and tamarack.

Grey-Wooded soils constitute the largest portion of the Granville association. These soils are more deeply leached than the Waitville soils due to the lower lime carbonate content of the parent material. A modal well-drained soil in the Granville association has the following profile features:

O —1 to 2 inches, very dark brown leaf mat, neutral to slightly acid in reaction.

A_1—0 to 1 inch, very dark grey loam; finely granular; very friable when moist, soft when dry; neutral to slightly acid in reaction.

A_2—3 to 5 inches, light grey to light greyish brown loam; platy to granular; friable when moist, slightly hard when dry; acid in reaction.

A_3—3 to 5 inches, pale brown loam; subangular blocky; friable when moist, slightly hard when dry; acid in reaction.

B_1—2 to 4 inches, light greyish brown clay loam; medium blocky; firm when moist, hard when dry; acid in reaction.

B_2—5 to 7 inches, greyish brown heavy clay loam; blocky to coarse blocky aggregates coated with brown clay skins; very firm when moist, very hard when dry; acid in reaction.

B_3—6 to 8 inches, light greyish brown loam; medium blocky; firm when moist, hard when dry; neutral in reaction.

Cca—8 to 15 inches, light greyish brown loam; pseudo-fragmental; firm when moist, cemented when dry; moderately alkaline and moderately calcareous.

C —Light greyish brown to greyish brown boulder till; fragmental; very firm when moist, cemented when dry; moderately alkaline and calcareous.

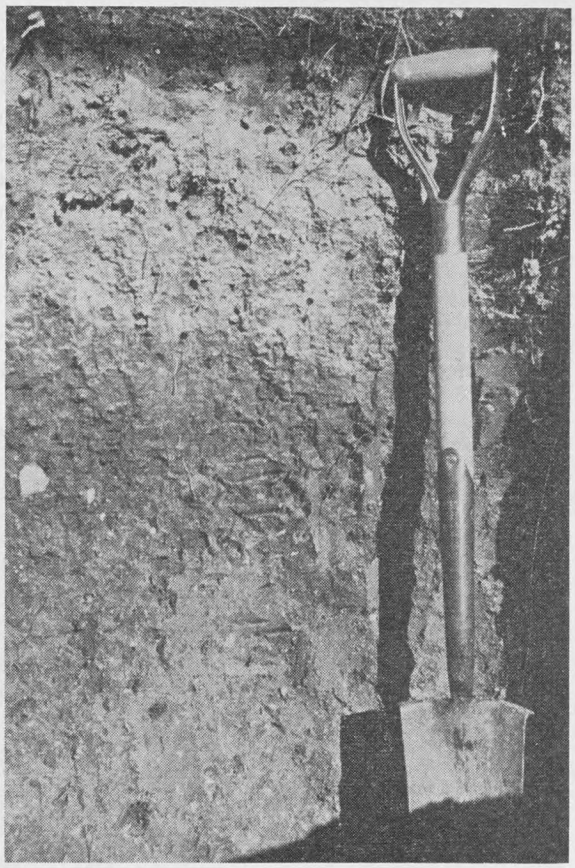


FIGURE 31

Soil profile of Granville loam. A Grey Wooded soil developed in moderately shaly till.

These soils are associated with Imperfectly Drained Grey Wooded, Grey Wooded Gley and Peaty Meadow soils. Bog or Half Bog soils occur in very poorly drained sites.

Agriculture: The Grey Wooded Granville soils have a moderate degree of natural fertility. Moisture-holding capacity is moderately good and the soil reaction is favorable for plant growth. Although the surface horizons are acid, lime occurs within the root depth of field crops. The organic reserve is low and crops respond very favorably to nitrogen fertilizers. Soil erosion by water is the most serious problem in soils under cultivation as the topography is rough and slopes are steep.

The soils are suited to mixed farming and best adapted to crop rotations which include two to three years of grass-legume crops. The fibre supplied by the grass crop helps protect the soil against erosion by water. The legume crop supplies nitrogen to the succeeding cereal crops. The steeper slopes should be retired to permanent grasses and legumes and hilly land presently under woods should not be broken.

GARSON COMPLEX (23,846 acres)

The Garson soil complex consists of Grey Wooded, Degrading Rendzina, Imperfectly Drained Grey Wooded and associated soils developed on strongly calcareous, lake-worked

till containing over 40 percent lime carbonate. These soils generally contain a thin sandy mantle up to 15 inches thick and may contain a thin gravel lens between the sandy surface and the underlying till. Surface textures vary from clay loam in the soils developed on till to loamy sand in soils developed on the sandy mantle. The Garson soils are all relatively stony at the surface.

The topography is smooth level to very gently sloping. Elongated low ridges and shallow swales trend in a north-northwest to south-southeast direction. These ridges lie across the direction of land fall and interfere with natural drainage. The low ridges are moderately well to imperfectly drained and the shallow swales are poorly to very poorly drained. The vegetation is predominantly aspen and balsam poplar on better-drained sites and willow, swamp birch, reeds and sedges in the poorly drained sites. The Imperfectly Drained Grey Wooded is the dominant better drained soil and may be described as follows:

FIGURE 32

Soil profile of Garson sandy loam. An Imperfectly Drained Grey Wooded soil with a thin sandy mantle underlain with strongly calcareous till.

O —1 to 2 inch, very dark brown leaf mat, neutral in reaction.

A_1—0 to 1 inch, dark grey sandy loam; finely granular; very friable; neutral in reaction.

A_2—1 to 3 inches, pale brown to brown sandy loam; friable when moist, slightly hard when dry; neutral to slightly acid in reaction.

B —4 to 7 inches, brown to greyish brown clay loam; fine to medium subangular blocky; firm when moist, hard when dry; neutral in reaction.

Cca—5 to 9 inches, pale yellow to light greyish brown loam; granular; friable when moist, cemented when dry; very strongly calcareous, moderately alkaline; weakly iron stained.

C —Very pale brown boulder till; loam in texture; granular to massive; friable when moist, cemented when dry; strongly calcareous, moderately alkaline; iron stained.

Associated soils include: Grey Wooded, Degrading Rendzina, Degrading Black-Meadow, Imperfectly Drained Degrading Rendzina, Calcareous Meadow and Peaty Meadow soils. The Peaty Meadow soils often grade into Half Bog organic soils which are underlain by mineral deposits similar to those on which the Garson soils are developed.

Agriculture: The Garson soils have low natural fertility. They have a low to moderate water-retention capacity and low reserve of organic matter. Soil drainage is dominantly imperfect. The limy substrate is often turned up during breaking and the cultivated soil layer contains excessive amounts of free lime carbonate.

Most of the Garson soils are too stony to cultivate. Arable areas are suited to mixed farming with major emphasis on livestock. Nonarable areas are utilized as pasture. Alfalfa for seed has been successfully produced on the better drained soils which occur adjacent to native bushland. Surface ponding of waters is a problem in wet seasons.

CLARKSVILLE ASSOCIATION (18,109 acres)

The Clarksville soils are developed on boulder till dominantly of shale origin. The parent material of these soils contains less lime carbonate than the parent materials of the Waitville and Granville soils. Surface textures vary from very fine sandy loam to loam. Some surface stones occur but in most areas they do not seriously interfere with cultivation.

The topography is irregular gently sloping to hilly. There is an overall slope to the eastward and numerous ravines carry surface runoff water across the soil area. A narrow end moraine, running parallel to the Neepawa River is marked by numerous elongated pot-holes. Otherwise, few undrained depressions are encountered. The soils on the slopes are well-drained as internal percolation is good and surface runoff is rapid. The native vegetation is predominantly aspen woods with an undergrowth of hazel, wild rose, saskatoon, chokecherry, etc.

Grey Wooded soils are the predominant genetic type. As the lime content of the parent material is low, they are more deeply leached than the adjacent Granville soils. A modal soil profile within this association may be described as follows:

O —1 to 2 inches, very dark brown leaf mat, neutral in reaction.

A_1—0 to 1 inch, very dark grey loam; finely granular; very friable when moist, slightly hard when dry; neutral to slightly acid in reaction.

A_2—5 to 10 inches, light grey loam; platy to finely granular; friable when moist, soft when dry; slightly acid in reaction.

A_3—4 to 8 inches, light greyish brown loam; granular to fine subangular blocky; friable when moist, hard when dry; slightly acid in reaction.

B_1—2 to 6 inches, greyish brown clay loam; subangular blocky; firm when moist, hard when dry; slightly acid in reaction.

B_2—5 to 10 inches, dark greyish brown clay loam: blocky to coarse blocky aggregates coated with clay skins; very firm when moist, very hard when dry; slightly acid in reaction.

B_3—4 to 14 inches, greyish brown loam; blocky aggregates grading to fine subangular blocky aggregates in the lower portion of the horizon; friable when moist, hard when dry; neutral in reaction; a few iron stone concretions.

Cca—A diffuse lime carbonate accumulation layer of light greyish brown loam; pseudo-granular; friable when moist, weakly cemented when dry; moderately alkaline, moderately calcareous; iron stone concretions.

C —Greyish brown loam; pseudo-granular; friable when moist, hard when dry; mildly alkaline in reaction, slightly calcareous; contains iron stone concretions.

Small areas of Imperfectly Drained Grey Wooded, Peaty Meadow and Grey Wooded Gley soils are associated with the predominant Grey Wooded soils.

Agriculture: The Clarksville soils have low to moderate natural fertility. They have a fair moisture-retention capacity and a soil reaction favorable to crop growth. However, they are deeply leached and have very little organic matter reserve. Most of the soil area has sloping topography and cultivated soils are subject to severe water erosion.

This soil area is suited to livestock production. Grain can be produced on the small areas with gently sloping topography. Steep slopes and hills are suited to permanent forage crops or in extreme cases should be reforested. Cultivated soil areas should be returned to grass-legume crops for two to three years out of six. The grass crops help to prevent erosion and legumes supply nitrogen to these soils of low natural fertility.

BLACKSTONE ASSOCIATION (In Riding Mountain National Park)

The Blackstone soils are developed on shale clay till of moderate to low lime carbonate content. The surface soils are clay to clay loam in texture. Occasional stones occur in the surface horizons.

The topography is irregular gently to moderately sloping. Surface runoff is good but internal percolation is slow. The native vegetation is aspen and balsam poplar along with white spruce and an undergrowth of willows, hazel, etc. on the better drained soils and willow, black spruce and tamarack in the depressions.

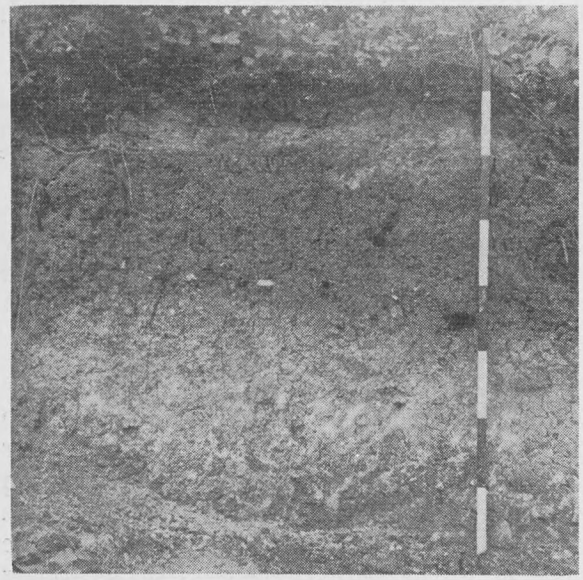


FIGURE 33
Soil profile of Blackstone clay. A Grey Wooded soil developed on shale clay till. (Measuring stick interval = 6 inches.)

The dominant soil is Grey Wooded and has the following profile features:

O —1 to 3 inches of very dark brown leaf mat: neutral.

A_1—0.5 to 2 inches, black clay loam; granular; friable when moist, hard when dry; slightly acid.

A_2—1 to 4 inches, dark to light grey clay loam; platy to granular; firm when moist, hard when dry; slightly acid to acid in reaction.

B_2—8 to 12 inches, dark grey to dark greyish brown clay; blocky; very firm when moist, extremely hard when dry; slightly acid to neutral in reaction.

B_3—3 to 6 inches, brownish grey to light brownish grey clay; blocky to fine blocky; very firm when moist, very hard when dry; mildly alkaline.

C —Light brownish grey to dark greyish brown clay till; pseudo-fragmental; very hard when dry; moderately alkaline; slightly iron stained.

Associated soils include: Imperfectly Drained Grey Wooded and Peaty Meadow members.

Agriculture: The Blackstone soils in the West-Lake area occur entirely within the park boundaries. In other areas, they are fair agricultural soils when cultivated and suited mainly to mixed farming.

WAPUS ASSOCIATION (4,631 acres)

The Wapus soils are developed on medium textured, shaly till deposits over shale rock. The shaly material from which these soils have developed is very low in lime carbonate content. Surface textures are generally very fine sandy loam and silt loam but vary from fine sandy loam to clay loam. Surface stones are not sufficiently numerous to interfere with cultivation, except on the steeper hillocks which are very stony.

The topography varies from smooth gently sloping to hilly. There is a sharp fall in elevation across the soil area and numerous deep gullies and ravines dissect the area. Although the topography is irregular there are few poorly drained depressions. Soil drainage is good due to the high permeability of the shaly till and underlying shale rock. The native vegetation is largely aspen along with some oak and an undergrowth of hazel, hawthorne, wild rose, etc.

The dominant soil is classed as a Grey Wooded type although the soil characteristics vary considerably depending on the lime content of the parent material. A generalized profile description of the dominant member is given on the following page:

O —1 to 2 inches, very dark brown leaf mat, neutral in reaction.

A_1—0 to 4 inches, dark grey very fine sandy loam; weakly fine granular; porous, very friable when moist, soft when dry; slightly acid to neutral in reaction.

A_2—12 to 20 inches, light grey very fine sandy loam; weakly granular; porous, very friable when moist, soft when dry; slightly acid in reaction.

B —20 inches or more of dark grey brown shale intermixed with some clay loam material; tendency to be blocky in structure; friable; acid in reaction. This often is a very diffuse horizon, but may be moderately developed.

Cca—Diffuse lime carbonate accumulation horizon; shale and shaly till material which is mildly alkaline in reaction.

C —Light greyish brown shale; neutral to mildly alkaline in reaction.

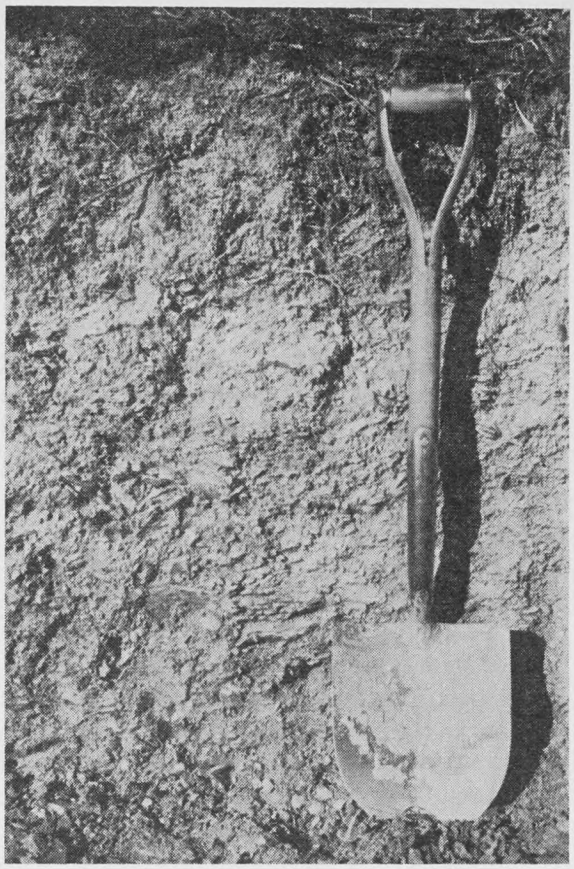


FIGURE 34

Soil profile of Wapus fine sandy loam. A Grey Wooded soil developed on shaly till deposits.

The presence of a relatively thick A_1 horizon in this soil may be attributed to a regradation process under grassland vegetation. Associated soils include: Imperfectly Drained Grey Wooded, Grey Wooded Gley, and Peaty Meadow members. Localized depressional areas usually contain alluvial sediments over the shale.

Agriculture: The Wapus soils have low natural fertility. They have low to moderate water-retention capacity and little to no organic matter reserve. In addition, the soils are very susceptible to erosion. They pulverize readily and are susceptible to wind damage, and the steeper slopes are susceptible to erosion by water.

The Wapus soils should be utilized for livestock production and forestry. The steeper slopes and ravines under cultivation should be planted with trees. The soils on smoother topography may be cultivated, but should be returned to grass-legume crops at least three years in six. The clearing of land now under trees should be discouraged. The clearing and cultivation of this land with the resulting increased runoff results in increased flood hazard on lower land areas to the east which contain some good to excellent agricultural soils.

RACKHAM ASSOCIATION (8,317 acres)

The Rackham soils are developed on coarse to medium textured lacustrine deposits which are underlain at variable depths below the soil profile by a substrate of glacial till. Surface texture varies from sandy loam to silty clay

loam. A few surface stones are encountered in areas where the lacustrine mantle is thin.

The topography is irregular very gently to steeply sloping in conformance with the undulations of the underlying till. The soils are predominantly well-drained as surface runoff is rapid and internal drainage is fair to good. The vegetation is principally aspen woods with some white spruce and an undergrowth of hazel and associated shrubs.

The Rackham soils are shown on the soil map and will be described as: (i) Rackham sandy loam, (ii) Rackham sandy loam, till substrate phase, (iii) Rackham clay loam and (iv) Rackham clay loam, till substrate phase.

(i) *Rackham sandy loam* (3,963 acres)

The Rackham sandy loam soils are characterized by deeply leached Grey Wooded profiles developed on sand to fine sand parent material. Surface textures are predominantly loamy fine sand but vary from sand to fine sandy loam. A representative virgin profile of this dominant member may be described as follows:

O —1 to 3 inches of very dark brown leaf mat, neutral in reaction.

A_1—0 to 1 inch, very dark grey loamy fine sand; weakly fine granular; very friable when moist, soft when dry; neutral to slightly acid in reaction.

A_2—6 to 8 inches, light grey to pale brown fine sand; structureless; loose; slightly acid in reaction. Grades into:

B_1—2 to 4 inches, pale brown fine sandy loam; weakly granular; very friable when moist, cemented when dry; slightly acid in reaction.

B_2—5 to 8 inches, brown fine sandy clay loam; coarse granular; firm when moist, hard when dry; slightly acid in reaction.

B_3—2 to 4 inches, light yellowish brown loamy fine sand; weakly granular to structureless; very friable to loose when moist, weakly cemented when dry; neutral to mildly alkaline in reaction.

Cca—4 to 10 inches, very pale brown fine sand; structureless; loose when moist, slightly cemented when dry; moderately calcareous, moderately alkaline.

C —Light grey to pale brown fine sand; structureless; loose, slightly calcareous, moderately alkaline.

Associated soils include: Imperfectly Drained Grey Wooded and Grey Wooded Gley members.

(ii) *Rackham sandy loam, till-substrate phase* (230 acres)

The soils in this phase are usually somewhat finer in texture than the modal Rackham sandy loam soils A larger percentage of the till substrate phase soils are imperfectly drained as the till substrate impedes internal drainage. The Grey Wooded soil profile is similar to that described for the Rackham sandy loam soil except that the solum (A and B horizons) is thinner and a till substrate occurs within 30 inches of the soil surface.

(iii) *Rackham clay loam* (553 acres)

The surface texture of the Rackham clay loam is predominantly very fine sandy clay loam but varies from very fine sandy loam to clay loam. A representative profile description of the dominant Grey Wooded member is given opposite Figure 35 on page 75.

Associated soils include: Imperfectly Drained Grey Wooded, Grey Wooded Gley, and Peaty Meadow soils.

(iv) *Rackham clay loam, till substrate phase* (3,571 acres)

The surface texture of this soil phase is the same as that of the Rackham clay loam soils. However, the soils are not as strongly degraded and Dark Grey Wooded soils are of common occurrence. These soils are characterized by a dark grey "A" horizon of 5 to 10 inches in thickness, which may be subdivided into a dark grey A_1 and a grey A_2 horizon, and a well developed dark greyish brown B horizon 5 to 8 inches thick. A boulder till substrate occurs within 30 inches of the soil surface.

Agriculture: The Rackham sandy loam soils have low to moderate natural fertility. The

O —1 to 3 inches, very dark brown leaf mat; neutral to slightly acid in reaction.

A_1—0 to 1 inch, very dark grey very fine sandy clay loam; finely granular; friable when moist, soft when dry; slightly acid in reaction.

A_2—2 to 6 inches, light brownish grey very fine sandy clay loam; weakly fine platy to granular; very friable when moist, soft when dry; slightly acid in reaction.

B_1—3 to 6 inches, greyish brown very fine sandy clay loam; fine subangular blocky; friable when moist, hard when dry; slightly acid in reaction.

B_2—5 to 7 inches, very dark greyish brown clay loam to heavy clay loam; blocky aggregates coated with clay skins; firm when moist, hard when dry; slightly acid in reaction.

B_3—4 to 6 inches, light yellowish brown very fine sandy clay loam to silty clay loam; subangular blocky to granular; friable when moist, slightly hard when dry; neutral to mildly alkaline in reaction.

Cca—Variable thickness of light grey very fine sandy loam; pseudo-granular; friable when moist, cemented when dry; moderately calcareous, moderately alkaline.

C —Very pale brown very fine sandy loam to silty clay; pseudo-granular; friable when moist, cemented when dry; moderately calcareous and alkaline.

FIGURE 35

Soil profile of Rackham clay loam. A Grey Wooded soil developed on medium textured lacustrine deposits. (Measuring stick interval = 6 inches.)

moisture-retention capacity is low and the soils have little reserve of organic matter. The single grained condition of these soils makes them very susceptible to wind erosion. The Rackham clay loam soils have moderate natural fertility. They have a low reserve of organic matter, but they have a fair to good moisture-retention capacity, a favorable soil reaction for plant growth and fairly good soil structure. However, the soils on sloping topography are subject to severe soil erosion by water.

The Rackham soils are generally suited to mixed farming. The coarser textured soils are suited to grass and legume crops although where the texture is coarsest these soils are suited only for forestry and wildlife. The finer textured soils can be utilized for cereal crops but should be returned to grasses and legumes for at least two years out of six. The steeper slopes should be utilized for permanent grass and legume crops while very sharp slopes are suited only to forestry.

ZAPOROZA ASSOCIATION (3,041 acres)

The Zaporoza soils are developed on gravelly and coarse sandy deposits of shale, limestone and granitic rock origin. Surface textures are usually sand but vary from coarse sand to sandy loam. The soil surface is relatively free of large stones, but some soils contain numerous small stones and cobbles in the surface soil horizons.

The topography is irregular gently sloping to hilly. Soil drainage is excessive as internal percolation is very rapid. The Zaporoza soils are covered by stunted aspen and oak woods.

FIGURE 36

Soil profile of Zaporoza coarse sandy loam. A Grey Wooded soil developed on shaly gravel outwash. (Measuring stick interval = 6 inches.)

The Grey Wooded soil features of the dominant soil member are only weakly to moderately developed. The weakly developed Grey Wooded soils on very coarse deposits have a well developed A_2 horizon and a very feebly developed B horizon. The moderately developed Grey Wooded soil on the finer textured materials has the following profile features:

O —1 to 2 inches of dark brown leaf mat, neutral in reaction.

A_1—Generally absent.

A_2—3 to 6 inches, light brownish grey coarse sand; structureless; loose; slightly acid in reaction.

B_1—3 to 5 inches, loamy coarse sand; weak granular aggregates; very friable when moist, soft when dry; slightly acid in reaction.

B_2—4 to 6 inches, yellowish brown loamy coarse sand; weak subangular blocky structure; very friable when moist, slightly hard when dry; neutral in reaction.

B_3—2 to 5 inches, light yellowish brown coarse sand and gravel; structureless; loose; mildly alkaline in reaction.

C —Coarse sand and gravel of limestone, shale and granitic rock origin.

Very small areas of Imperfectly Drained Grey Wooded soils occur in the association.

Agriculture: The Zaporoza soils have very low natural fertility. They have low moisture-retention capacity and little to no reserve of organic matter. The Zaporoza soils may be utilized for grazing, forestry or the preservation of wild life.

SOIL ASSOCIATIONS IN WHICH THE DOMINANT SOIL IS A RENDZINA

ISAFOLD ASSOCIATION (471,560 acres)

The Isafold soils are developed on boulder till of limestone and granitic rock origin which contains over 40 percent lime carbonate. Due to the complex pattern in which they occur, soils with a sandy mantle of less than 15 inches over the boulder till have been included in the Isafold association. The surface texture is generally fine sandy loam to loam but varies from loamy sand to clay loam. Surface stoniness is severe, especially in areas where the boulder till has been modified by lake washing during the recession of glacial Lake Agassiz.

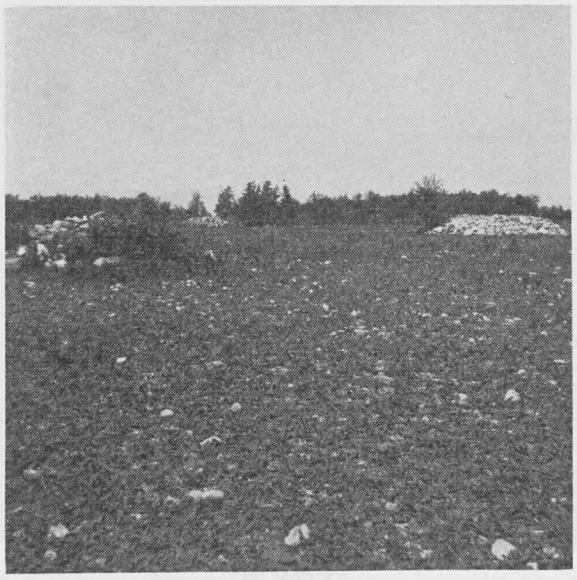


FIGURE 37
Cleared field in Isafold soil area showing extreme stoniness

Surface stones are numerous but do not prevent cultivation in the areas which have a relatively thick sandy mantle and in areas in which the boulder till parent material has not been severely reworked by lake waters.

The topography of the Isafold soil area varies from nearly level to very gently sloping. There is a ridge and swale micro-relief pattern which trends in a north-northwest to south-southeast direction. These elongate ridges and swales lie across the direction of land fall. Surface runoff accumulates in the swales forming meadows, sloughs and shallow lakes. The micro-ridges are predominantly imperfectly drained as surface runoff is moderate to slow and internal drainage is slow. The native vegetation is scrubby aspen and oak woods interspersed among open patches of tall-prairie and meadow-prairie grasses. The depressional sites are covered by meadow grasses along with some willows, reeds and sedges.

The Imperfectly Drained Rendzina soil constitutes the largest part of the association. A profile description that characterizes this genetic type is given opposite Figure 38 on page 78.

Associated soils include: well-drained Rendzina, Calcareous Meadow, Peaty Meadow and Saline Meadow soils. The Rendzina soils occur on the top of micro-ridges. The poorly drained soils are predominantly Calcareous Meadow and Peaty Meadow soils. Saline Meadow soils constitute a very minor portion of the association. A thin layer of coarse to medium textured lacustrine sediments commonly occurs over the calcareous till in the poorly drained sites.

Agriculture: The Isafold soils have moderate to low natural fertility. They have a small reserve of organic matter and a fair to good moisture retention capacity. However, they contain an excessive amount of free lime carbonate in the surface horizons which adversely affects the availability of soil phosphorus. Drainage is imperfect to poor and considerable surface ponding of water occurs in wet years. In addition, tillage is severely hampered, and in many cases prevented, by the occurrence of surface stones.

FIGURE 38

Soil profile of Isafold loam. An imperfectly drained Rendzina soil developed on strongly calcareous till. (Measuring stick interval = 6 inches.)

A —4 to 8 inches, very dark grey loam, high in organic matter; fine granular; friable when moist, hard when dry; moderately calcareous. Grades sharply into:

Cca—4 to 8 inches, light brownish grey loam; fine pseudo-granular; very friable when moist, cemented when dry; very strongly calcareous. This horizon often contains an unconforming layer of sand or gravel. Grades into:

C —Light grey to pale brown, loam, reworked, strongly calcareous till; pseudo-granular; firm when moist, cemented when dry; weakly iron stained.

The Isafold soils may be utilized for mixed farming with major emphasis on livestock production. The large areas of stony nonarable land are best suited for use as pasture. The degree of surface stoniness determines the amount of land that can be cultivated. The deficiency in phosphate common to these soils may be largely offset by the use of phosphate fertilizers drilled in with the seed. Livestock pastured on the Isafold soils should be fed a phosphate supplement to offset the deficiency in phosphorus common to forage produced on these soils. Considerable success has been experienced in producing alfalfa seed on the Isafold soils, especially where the native woodland vegetation has been left adjacent to the fields. Larger farm holdings on these soils should be encouraged as only a meagre living has been obtained by mixed farming on one-quarter section farms.

ALLUVIAL SOILS

EDWARDS ASSOCIATION (51,679 acres)

The Edwards soils are developed on recent alluvial deposits of low to moderate lime content. The surface textures are predominantly silty clay loam to silty clay but vary from fine sandy clay loam to clay. The surface horizons are stonefree except in local areas where the alluvial deposits are thin and are underlain by stony boulder till.

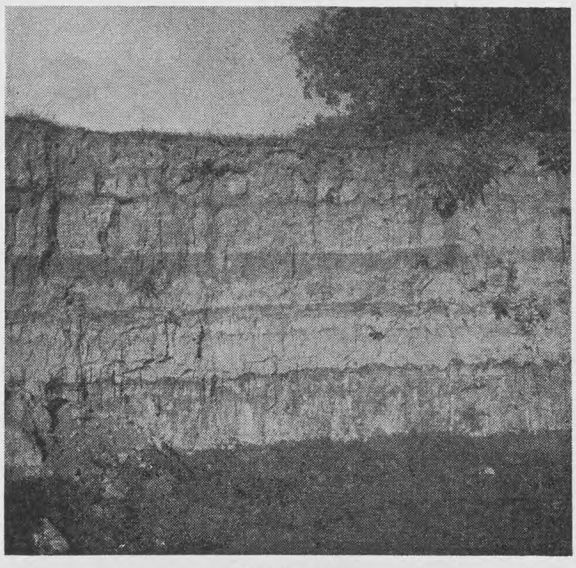


FIGURE 39

Recent alluvial deposits in the Edwards association showing a succession of dark layers of former surfaces.

The topography is smooth level to very gently sloping. The greatest degree of relief occurs on the coarser textured soils which occur near and adjacent to the stream channels. The topography is flat in the peripheral sections of the flood plains. Near the stream channels soil drainage is moderate to good, but on the flat topography soil drainage is imperfect to poor. The native vegetation is composed of elm, ash, Manitoba maple, willow, and cranberry along with ferns and associated herbaceous vegetation.

The Edwards soils have been divided on the basis of degree of maturity and composition of the parent material into: (i) Edwards silty clay loam to silty clay, (ii) Edwards, shaly phase and (iii) Edwards, semi-mature phase.

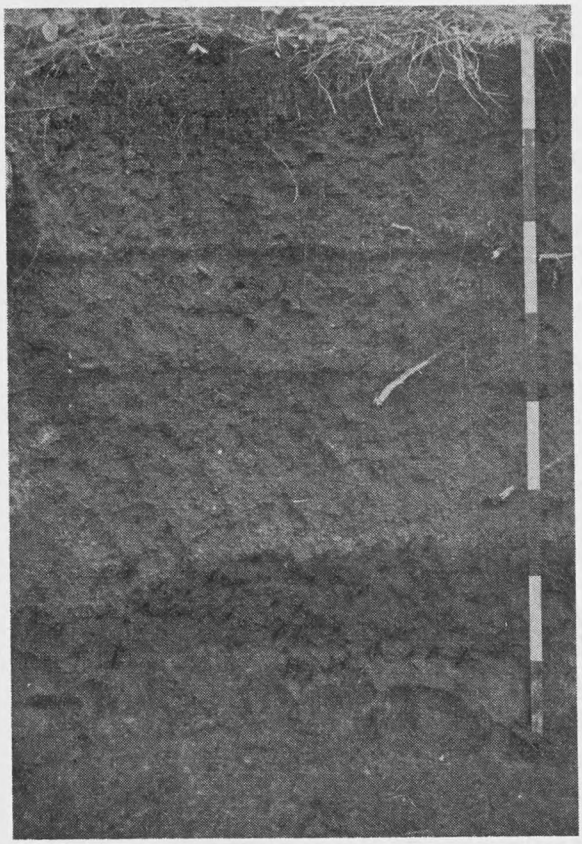


FIGURE 40

Soil profile of Edwards silty clay loam. An immature soil showing dark layers of former surfaces. (Measuring stick interval = 6 inches.)

(i) *Edwards silty clay loam to silty clay* (35,113 acres)

The surface texture of the soils in this phase varies from fine sandy loam to silty clay but is dominantly in the range of silty clay loam to silty clay. The soil profiles are marked by several dark grey bands which represent weakly developed "A" horizons that have been subsequently covered by additional alluvium. Cultivated fields have a greyish to greyish brown surface color. The soils are granular-structured; friable and porous; and slightly alkaline in reaction. Small areas of soils in old creek channels and in depressional areas are poorly drained weakly calcareous and iron stained.

(ii) *Edwards, shaly phase* (9,769 acres)

The surface textures in this phase are predominantly silt loam to silty clay loam but vary from fine sandy loam to silty clay. The soil profiles are similar to those of the Edwards silty clay loam to silty clay soils with the exception that the parent material contains a large percentage of coarse to fine shale gravel. This feature detracts from the agricultural potential of the shaly phase soils.

(iii) *Edwards, semi-mature phase* (6,797 acres)

The Edwards semi-mature phase soils have moderately well-developed "A" horizons. Surface textures are predominantly silty clay but vary from clay loam to clay. The imperfectly drained soil profile has a very dark grey A horizon which is granular; friable to firm when moist, hard when dry; and mildly alkaline in reaction. The A horizon grades into a greyish brown C horizon which is granular to massive; plastic and sticky when wet, very hard when dry; mildly alkaline in reaction and weakly iron stained. One or more dark bands of organic matter, representing old surface horizons, are distinguishable in the subsoil. Associated poorly drained soils resemble Meadow and Peaty Meadow genetic soil types with the exception that the subsoils contain dark organic bands.

In some areas of this soil phase, a boulder till substrate occurs within 30 inches of the soil surface. These areas were mapped as Edwards semi-mature, till substrate phase. With the exception of the till layer below the profile, these soils are similar to the modal Edwards semi-mature soils.

Agriculture: The Edwards soils have moderate to high natural fertility. The Edwards silty clay loam to silty clay soils have good moisture-retention capacity, a fair reserve of organic matter, moderately good drainage and soil tilth and are excellent agricultural soils. The Edwards shaly phase soils have fair moisture-retention capacity, a limited reserve of organic matter, fair to good drainage and are good agricultural soils. The Edwards semi-mature phase soils have very good moisture-retention capacity and a good reserve of organic matter but soil drainage is imperfect to poor. In dry years this soil phase produces excellent crops, but in wet years surface flooding and water-logging is a hazard.

The Edwards soils are suited to all regionally adapted crops. Good yields of cereals and forage are produced on these soils. Legumes grow well and are valuable in increasing the supply of available nitrogen in the immature Edwards soils and improving soil drainage in the fine textured, semi-mature Edwards soils. Occasional floods on the Edwards soil areas are a perpetual hazard. The soil profile is a record of successive floods through the centuries.

GLADSTONE ASSOCIATION (2,949 acres)

The Gladstone soils are developed on alluvial deposits of moderate to high lime content. Surface textures are predominantly clay loams but vary from very fine sandy loam to silty clay.

The topography is level, and the soils are largely imperfectly drained as surface and internal drainage are slow. The native vegetation prior to settlement was meadow-prairie and meadow grasses and herbs with elm, ash and other trees common to flood plains bordering the channels.

The Gladstone soils have been divided on the basis of degree of maturity into: (i) Gladstone silt loam to silty clay and (ii) Gladstone silt loam to silty clay, semi-mature phase.

(i) *Gladstone silt loam to silty clay* (2,143 acres)

The soils in this phase have very weakly developed A horizons which blend into a gleyed, porous, light grey to greyish brown, calcareous C horizon. Bands of organic matter, which represent A horizons that were subsequently covered by additional alluvium, occur within the subsoil. The poorly drained soils are usually finer textured and more calcareous than the imperfectly drained soils.

(ii) *Gladstone silt loam to silty clay, semi-mature phase* (806 acres)

The soils of this phase have very dark grey A horizons which are granular; friable when moist, hard when dry; alkaline and slightly calcareous. The A horizon grades into a calcareous, weakly gleyed, grey C horizon. The poorly drained members are finer in texture than the imperfectly drained soils and resemble Meadow and Peaty Meadow genetic types.

Agriculture: The Gladstone soils are moderately fertile. They have good moisture-holding capacity, a fair to good reserve of organic matter and, as they are developed on alluvium, the subsoil material is relatively fertile. However, they contain free lime carbonate in the surface horizons.

The soils are suited to grain and forage production, row crops, and a variety of fruits common to this climatic region. The low-lying areas are periodically flooded in the spring. Forage crops should be included in the soil rotation to maintain soil fibre and improve drainage on the finer textured Gladstone soils.

ASSINIBOINE COMPLEX (2,465 acres)

The alluvial materials which form the bottom lands in the Minnedosa River Valley are

collectively referred to as the Assiniboine complex. Surface textures vary from silty clay loam to clay.

The topography is level to very gently sloping. The soils are imperfectly to poorly drained as surface runoff and internal drainage is slow. Some low lying areas are subject to flooding by river waters in seasons of high rainfall. The native vegetation is elm, ash, and willow on the better drained sites and willow, meadow grasses, reeds and sedges on the poorly drained sites.

The genetic soil types encountered in this soil complex include: Degrading Black, Black, A-C alluvial and C alluvial soils. The alluvial soils compose the largest part of the soil complex. Thin peat deposits may occur in poorly drained areas.

Agriculture: The Assiniboine soils are naturally fertile. They contain a good reserve of organic matter and retain moisture well. The better-drained soils are well suited to cereal and forage crops. Low areas are subject to flooding and these soils often are waterlogged. These poorly drained areas are suited only to forage production and pasture.

PROVEN LAKE ASSOCIATION (184 acres)

The Proven Lake soils are developed on thin alluvial deposits of clay and silty clay texture that are underlain by till or reworked till. These deposits occur in small isolated pockets usually surrounding lakes. Surface texture is silty clay loam to clay. The soil surface is usually stonefree.

The topography is level to very gently sloping. Drainage is poor as surface runoff and internal drainage are slow. The native vegetation consists of balsam poplar, willows, meadow grasses, reeds and sedges.

The soils have semi-mature profiles. The better-drained soils have very dark grey, clay "A" horizons that are granular; plastic when wet, friable when moist, very hard when dry; and slightly alkaline in reaction. This horizon tongues into a grey, clay "C" horizon that is massive; very plastic and sticky when wet, very hard when dry; moderately calcareous and iron stained. A "D" horizon of calcareous resorted till occurs as a substrate.

Associated soils are Meadow and Peaty Meadow types. The "A" horizon in these soils is very weakly developed.

Agriculture: The Proven Lake soils have fair natural fertility. They have good moisture-retention capacity and a low to moderate supply of organic matter. However, they have poor soil tilth, drainage is poor and the soils are subject to occasional flooding. The better-drained soil areas may be utilized for grain production, but the poorly drained areas are suited only to hay, pasture or wildlife.

ORGANIC SOILS

HALF BOG (74,327 acres)

The soils that have been designated as Half Bog soils consist of organic deposits of 12 to 30 inches in thickness. The peat deposits lie over mineral material in which a weakly developed A horizon may be distinguished.

The Half Bog deposits have smooth topography and they usually occupy the depressional areas. These areas are very poorly drained and the peat deposits are saturated with water for the largest portion of the growing season. The native vegetation is variable. On the Riding Mountain the vegetation may be black spruce and tamarack with associated growths of leatherleaf and moss. In the Lowland Plain the vegetation usually is reeds and sedges along with some willow.

The composition of the Half Bog soils is dependent on the type of native vegetation from which they were formed. The peat deposits on the Riding Mountain are usually mixed woody, moss and fen peats, whereas the deposits on the Lowland Plain are dominantly fen peat. A few local areas of muck or decomposing peat are encountered but most of the Half Bog peats are relatively undecomposed.

The mixed peats are usually acid in reaction, whereas the fen peats are slightly acid to neutral in reaction.

Agriculture: The Half Bog soils have low natural fertility. Agriculturally they are best suited as hay or pasture land. They are very poorly drained soils and the water level is difficult to control. In some places the peat has been destroyed by fires and the mineral soils below are being farmed. Before this practice is followed, it is important to ascertain the nature of the underlying soil as it is often stony or very sandy and unsuited to cultivation. Some Half Bog areas provide a habitat for waterfowl, muskrats and other forms of wildlife.

BOG (13,594 acres)

The areas that have been designated as Bog soils are composed of organic deposits of 30 or more inches in thickness. The peat deposits lie over mineral material in which little or no profile development can be distinguished.

The Bog deposits have smooth level topography. They occur in areas which are very poorly drained and the organic deposits are normally saturated with water throughout the year. The vegetation varies from the spruce-tamarack type which is prevalent on the Riding Mountain, to reeds and sedge vegetation commonly encountered on the Lowland Plain.

The composition of the organic deposits is dependent on tne type of vegetation from which they were formed. The deposits may be of fen (grass-like plants), moss or woody origin. The woody and moss peats are acid in reaction and the fen peat is slightly acid in reaction.

Agriculture: The Bog soils are suited primarily to wild-life. Some areas can be drained and consequently the peat can be destroyed by burning. The mineral soil below is usually very infertile and not worth the cost of reclamation. In addition, such reclaimed lands are usually subject to recurrent flooding as the soil area occupies a depressional position in the landscape.

UNCLASSIFIED SOILS

ERODED SLOPES COMPLEX (28,247 acres)

The Eroded Slopes complex consists of truncated soils and lithosols on steep slopes. Texture is extremely variable. Most of the slopes are covered by woodland vegetation, but local talus slopes in ravines along the eastern edge of the Riding Mountain are devoid of vegetation. In general the south and west-facing slopes are covered by areas of woods and prairie grasses, whereas the north and east-facing slopes are thickly wooded.

Agriculture: The eroded slopes are suited to tree growth and wild life. Some areas can be utilized for limited grazing. The native vegetation protects the slopes from excessive erosion and provides food and shelter for game birds and animals.

BENCHLANDS COMPLEX (3,064 acres)

The Benchlands complex consists of variable textured soils occurring on the valley terraces of the Minnedosa River. These soils are developed on a thin surface mantle of medium to fine textured alluvial and outwash deposits over a substratum which may consist of cobbles, gravel, sand or reworked boulder till.

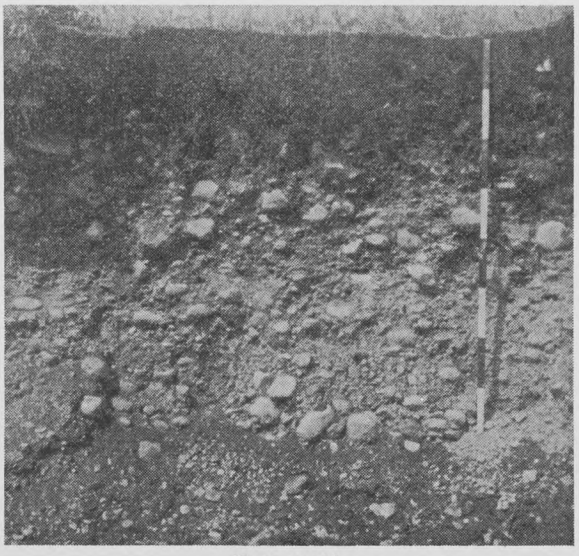


FIGURE 41
Soil profile characteristic of Benchlands complex. A Black soil developed on gravel and cobbles. (Measuring stick interval = 6 inches.)

The topography is smooth, very gently sloping and the drainage is good to excessive as internal percolation through the coarse textured subsoils is rapid. The native vegetation is prairie grasses with scattered groves of aspen.

The soils are predominantly Blacks. No representative profile description can be given of this complex soil group. Generally the A horizon is restricted to the finer textured surface layer which is very dark grey in color, granular, friable and neutral in reaction. The subsoil is alkaline and calcareous.

Agriculture: The natural fertility of these soils varies considerably. Where the surface mantle is a foot or more thick the soils are fairly fertile. The coarse-textured soils with a thin surface mantle have low natural fertility.

The more fertile Benchlands soils are suited to mixed farming. These soils are however subject to drought because of the gravelly substrate. The coarse-textured soils and the stony soil areas are suited only for hay and pasture.

E. ESTIMATED SUITABILITY OF SOILS FOR AGRICULTURAL USE

The estimated suitability of the soils of West-Lake map area for various purposes is shown in Table 7. The ratings contained in this table are based on general observations and on a study of the characteristics expressed in the individual soil profiles. They are not based on crop yield data (which are not available), but represent the considered opinion of the soil surveyors.

These land-use estimates represent the average suitability of each map unit in normal seasons. In seasons of above average precipitation, many of the soils will give different returns than are indicated, and in seasons of severe drought even the best soils may give less satisfactory returns. Further, the respective average estimates must be modified on each farm to conform with local variations in drainage, stoniness and topography.

F. LAND-USE CAPABILITY CLASSES

The soils which occur in the West-Lake map area can be grouped into land-use capability classes on the basis of observed characteristics such as soil depth, texture, slope, erosion, stoniness, salinity, drainage and fertility. Brief descriptions of the eight recognized land-use capability classes, together with a list of the soils that may be placed in each class, are given under the following headings:

(a) *Land Suited to Arable Culture*

Class I—Land of very good productivity. Highly productive soils on land that is level to very gently sloping. Some local areas may need clearing, provision for water control and fertility maintenance. Good farming methods are essential to keep the soil in good condition and to control weeds, diseases and insect pests. The following soils may be listed in this category:

Edwards silt loam to silty clay
Edwards semi-mature phase
Gladstone silt loam to silty clay
Gladstone semi-mature phase

Class II—Land of good productivity. Good soils on land that is level to gently sloping. Some areas in certain soil associations may be slightly stony, some may require moderate drainage and some areas may be subject to wind and water erosion or may require improvement in workability. The following soils may be listed in this category:

Wellwood loam, till substrate phase
Carroll loam
Carroll loam, till substrate phase
Newdale undulating phase
Erickson association
Newdale smooth phase
Tobarmore association
Edwards shaly phase
Dauphin clay
Dauphin clay, till substrate phase
Norgate association

Class III—Land of moderate productivity. Soils in this land class are limited in productivity due to one or more of a number of factors such as: susceptibility to wind and water erosion, limited fertility, soil drought (due to sandy texture or to physiological drought resulting from excess lime carbonate), salinity, stoniness, poor drainage, etc. These limitations

TABLE 7

Estimated Suitability of Soils in the West-Lake Map Area for Various Purposes

Rating Symbols: E = excellent; E-G = excellent to good; G-E = good to excellent; G = good; G-F = good to fair; F-G = fair to good; F = fair; F-P = fair to poor; P-F = poor to fair; P = Poor; VP = very poor; V = variable; X = not naturally favorable, but could be used if suitable corrective measures were adopted; ++ = well adapted; +− = more or less suitable; −− = not suitable, or of relatively low value.

Textural Symbols: S = sand; LS = loamy sand; LFS = loamy fine sand; SL = sandy loam; FSL = fine sandy loam; L = loam; SiL = silt loam; CL = clay loam; SiC = silty clay; C = clay.

Note: The following estimates are given as a guide to the average suitability of each soil map unit for land-use in average seasons.

Soil Designation	CULTIVATED LAND								UNBROKEN LAND				
	Grain Crops		Intertilled Crops			Cultivated Hay and Pasture Crops		Gardens and Fruits	Native Hay	Grazing	Wild Life	Forestry	Field Windbreaks
	Wheat	Coarse Grains	Fodder Corn	Seed Corn	Roots and Potatoes	Grasses	Legumes						
Agassiz Association:													
Agassiz LS	−−	−−	−−	−−	−−	P	P	−−	P	P-F	+−	−−	−−
Agassiz LS., till substrate phase	P	P	−−	−−	−−	P-F	P-F	P	P-F	F	+−	−−	+−
Agassiz LS., sand substrate phase	P	P	−−	−−	−−	P-F	P-F	P	P-F	F	+−	−−	+−
Almasippi Association:													
Almasippi LFS	F	F	G	F	F	G	G	G-F	F	G	+−	++	++
Almasippi LFS., till substrate phase	F	F	F	F-P	F	G	G-F	F	F	G	+−	+−	+−
Almasippi FSL	F	F-G	G	F	F	G	G-F	F	F-G	G	+−	+−	+−
Arden Association:													
Arden L	G-F	G	X	X	F	F-G	F-G	F	F	F	+−	−−	+−
Arden L., gravel lens phase	F	F-G	X	P	P	F	F	P-F	F	F	+−	−−	+−
Assiniboine Complex	(V)E-P	(V)E-P	(V)E-P	(V)G-P	(V)E-P	(V)E-F	(V)E-F	(V)E-F	(V)G-P	(V)E-F	++	+−	++
Benchland Complex	P-F	F-P	F-P	P	F-P	F-G	F	F-P	F	F	+−	+−	+−
Birnie Association	G	G	G	F	G-F	G	G	G	F-G	G	+−	−−	++
Blackstone Association	F-P	F	−−	−−	F	G-E	G-E	F	P	P	++	++	++
Bog	−	−	−	−	−	X	−	−	X	X	(V)+−	(V)+−	−
Carroll Association:													
Carroll L	G-E	G	G	G-F	G	G	G	G	−	−	−−	−−	++
Carroll L., till substrate phase	G-E	G	G	G-F	G	G	G	G	−	−	−−	−−	++
Clarksville Association	P-F	P-F	−−	−−	P-F	F-G	G-F	F	P-F	F	++	++	++
Dauphin Association:													
Dauphin C	G	G-E	F-G	−−	F-G	G-E	G	F	F-G	F-G	−−	−−	+−
Dauphin C., till substrate phase	G	G	F-G	−−	F	G-E	G	F	F-G	F-G	−−	−−	+−
Edwards Association:													
Edwards SL to SiC	G-E	E-G	G-E	−−	E	E	E-G	E	G	G	+−	++	++
Edwards, shaly phase	G	G	G-E	−−	G-E	E	E-G	E	G	G	+−	++	++
Edwards, semi-mature phase	G-E	E	G-E	−−	G-E	E	G-E	G-E	G-E	G-E	+−	+−	++
Erickson Association	G	G-E	−−	−−	G	G	G-E	G-F	F	F-G	++	+−	++
Eroded Slopes	−−	−−	−−	−−	−−	−−	−−	−−	−−	+−	++	++	−

TABLE 7—(Continued)

Estimated Suitability of Soils in the West-Lake Map Area for Various Purposes

Rating Symbols: E = excellent; E-G = excellent to good; G-E = good to excellent; G = good; G-F = good to fair; F-G = fair to good; F = fair; F-P = fair to poor; P-F = poor to fair; P = Poor; VP = very poor; V = variable; X = not naturally favorable, but could be used if suitable corrective measures were adopted; ++ = well adapted; +− = more or less suitable; −− = not suitable, or of relatively low value.

Textural Symbols: S = sand; LS = loamy sand; LFS = loamy fine sand; SL = sandy loam; FSL = fine sandy loam; L = loam; SiL = silt loam; CL = clay loam; SiC = silty clay; C = clay.

Note: The following estimates are given as a guide to the average suitability of each soil map unit for land-use in average seasons.

Soil Designation	CULTIVATED LAND								UNBROKEN LAND				
	Grain Crops		Intertilled Crops			Cultivated Hay and Pasture Crops		Gardens and Fruits	Native Hay	Grazing	Wild Life	Forestry	Field Windbreaks
	Wheat	Coarse Grains	Fodder Corn	Seed Corn	Roots and Potatoes	Grasses	Legumes						
Gladstone Association:													
Gladstone SiL to SC	G-E	G-E	G	−−	G-E	E-G	G-E	G-E	G	G	+−	++	++
Gladstone semi-mature phase	G-E	G-E	G	−−	G-E	E-G	E-G	G	G	G	+−	+−	++
Garson Complex	(V)P	(V)P	−−	−−	(V)P-F	F-G	G-F	F-P	P	F	+−	+−	+−
Gilbert Association:													
Gilbert SL	F	F	−−	−−	F	F-G	G	F-G	F-G	F-G	+−	+−	++
Gilbert SL., till substrate phase	F	F	−−	−−	F	F-G	F-G	F	F-G	F-G	+−	+−	++
Granville Association	P-F	F	−−	−−	F-P	F-G	G-F	F	P-F	F	++	++	++
Half Bog	−−	−−	−−	−−	−−	(V)F	−−	−−	V(F)	V(F)	(V)+−	+−	−
Isafold Association	(V)P-F	(V)P-F	−−	−−	(V)P-F	F-G	(V)F-G	(V)P-F	F	F-G	+−	−−	+−
Keld Association	−−	−−	−−	−−	−−	G-F	−−	−−	F-G	F-G	+−	+−	+−
Kelwood Association	F	F-G	−−	−−	F-P	F-G	F-G	F	F	F-G	+−	+−	+−
Lakeland Association:													
Lakeland L	F-G	F-G	F	−−	F	F-G	F-G	F	F-G	F-G	−−	−−	+−
Lakeland L., till substrate phase	F	F-G	F	−−	F	F-G	F	F	F-G	F-G	−−	−−	+−
Lakeland CL	G-F	G-F	F	−−	F	G	G-F	F	F-G	F-G	−−	−−	+−
Lakeland CL., till substrate phase	F-G	F-G	F	−−	F	G	F	F	F-G	F-G	−−	−−	+−
Leary Association:													
Leary LS	−−	−−	−−	−−	−−	P	P	−−	−−	+−	+−	−−	+−
Leary LS., till substrate phase	P	P	−−	−−	−−	P	P-F	P	P	P-F	+−	−−	+−
Leary LS., sand substrate phase	P	P	−−	−−	−−	P	P-F	P	P	P	+−	−−	+−
Marringhurst Association	P	(V)P	P-F	P	P	P-F	P	P	P-F	F	−−	−−	+−
McCreary Association	F-G	G	F	−−	F	G-E	G	F	F-G	F-G	+−	−−	+−
Meadowbrook Association	F-G	G	−−	−−	F-P	G	G-E	F-G	F	F	+−	+−	++
Miniota Association	F-P	F-P	F-P	P	P-F	F	F	F	F-P	F	−−	−−	+−
Newdale Association:													
Newdale undulating phase	G-E	E-G	−−	−−	G	G	G	G	F-G	G-F	+−	+−	++
Newdale smooth phase	G	G	−−	−−	G-F	G-F	G	G-F	F-G	G-F	+−	−−	+−

TABLE 7—(Continued)

Estimated Suitability of Soils in the West-Lake Map Area for Various Purposes

Rating Symbols: E = excellent; E-G = excellent to good; G-E = good to excellent; G = good; G-F = good to fair; F-G = fair to good; F = fair; F-P = fair to poor; P-F = poor to fair; P = Poor; VP = very poor; V = variable; X = not naturally favorable, but could be used if suitable corrective measures were adopted; ++ = well adapted; +− = more or less suitable; −− = not suitable, or of relatively low value.

Textural Symbols: S = sand; LS = loamy sand; LFS = loamy fine sand; SL = sandy loam; FSL = fine sandy loam; L = loam; SiL = silt loam; CL = clay loam; SiC = silty clay; C = clay.

Note: The following estimates are given as a guide to the average suitability of each soil map unit for land-use in average seasons.

Soil Designation	CULTIVATED LAND								UNBROKEN LAND				
	Grain Crops		Intertilled Crops			Cultivated Hay and Pasture Crops		Gardens and Fruits	Native Hay	Grazing	Wild Life	Forestry	Field Windbreaks
	Wheat	Coarse Grains	Fodder Corn	Seed Corn	Roots and Potatoes	Grasses	Legumes						
Norgate Association	G	G	−−	−−	F	G	G	G-F	F	F	+−	+−	++
Onanole Association:													
Onanole SL	F-P	F-P	−−	−−	F-P	F	F	F-P	F-P	F	++	+−	++
Onanole CL	F-G	G	−−	−−	G-F	G	G	G-F	F	F-G	++	+−	++
Onanole CL., till substrate phase	F	F-G	−−	−−	F	G	G	F-G	F	F-G	++	+−	++
Proven Lake Association	P	P-F	−−	−−	F	G	F	F-P	G-F	F	+−	+−	−
Quercus Association	F-G	F-G	−−	−−	F-G	G	G-E	G	F	F	+−	+−	−
Rackham Association:													
Rackham SL	P	P-F	−−	−−	F-P	F	F	F-P	F-P	F	+−	++	++
Rackham SL., till substrate phase	P	P-F	−−	−−	F	F-G	F	F	F-P	F	+−	++	++
Rackham CL	F	F-G	−−	−−	F-G	G	G	G-F	F	F-G	+−	++	+−
Rackham CL., till substrate phase	F	F-G	−−	−−	F-G	G	G	G-F	F	F-G	+−	++	+−
Seech Association	(V)P	P	−−	−−	P	P-F	P-F	P	P-F	F	+−	−−	+−
Selina Association:													
Selina S	P-F	P-F	−−	−−	P-F	F	F	P-F	F	F	+−	+−	++
Selina S., till substrate phase	P	P-F	−−	−−	P-F	F	P-F	P	F	F	+−	+−	++
Stockton Association:													
Stockton LS	P-F	P-F	F	P	F-P	F	F	P-F	F	F	++	+−	++
Stockton FSL	F-G	F	G-F	P-F	F	F	F-G	F-P	F	F	+−	−−	++
Stockton FSL., till substrate phase	F	F	F	P	F	F-G	F-G	F	F	F-P	+−	+−	++
Tobarmore Association	P-F	P-F	−−	−−	P	F-P	F-P	F-P	P	P-F	+−	−−	+−
Waitville Association	F	F	−−	−−	F	F-G	F-G	F	P-F	F-P	++	+−	++
Wapus Association	P-F	P	−−	−−	P	F	F	F	P	P-F	+−	+−	++
Wellwood Association:													
Wellwood L., till substrate phase	G-E	G-E	G-F	P	G-F	G-E	G-E	G-E	G	G	+−	−−	++
Westbourne Association	F-P	F	P	P	P	F	F	P	F	F	−−	−−	+−
Zaporoza Association	−−	−−	−−	−−	−−	F	F-P	P	F-P	F	+−	−−	+−

may be of the same kind as those noted in Class II land, but the limiting factors are effective to a greater degree. The following soils may be listed in this category:

Lakeland clay loam
Arden loam
Onanole clay loam
Onanole clay loam, till substrate phase
Lakeland loam
Lakeland clay loam, till substrate phase
Quercus association
Meadowbrook association
Stockton fine sandy loam
Rackham clay loam
Rackham clay loam, till substrate phase
Lakeland loam, till substrate phase
Kelwood association
Almasippi fine sandy loam
Assiniboine complex
Almasippi loamy fine sand
Almasippi loamy fine sand, till substrate phase
Waitville association
Westbourne association
Onanole sandy loam
Miniota association
Granville association
Blackstone association

(b) *Land Suited to Limited Arable Culture*

Class IV—Land of limited productivity. Soils in this class are best suited for hay, pasture, or forestry, but may include local areas of somewhat better soils that can be used for crop production to a limited extent. Limitations of this class are low fertility, unfavorable topography, stoniness, or arrested drainage. The following soils may be listed in this category:

Stockton loamy sand
Benchlands complex
Birnie association
Isafold association
Selina sand
Wapus association
Clarksville association
Rackham sandy loam
Rackham sandy loam, till substrate phase
Selina sand, till substrate phase
Proven Lake association
Garson complex

(c) *Land Not Generally Suited to Arable Culture*

Class V—Land suited chiefly for grazing, hay or forestry. The soils in this class are generally on level to gently sloping topography and are not particularly subject to erosion, but they are not suited for general crop production because they are either stony, salinized, calcareous, infertile, gravelly, coarse textured or poorly drained. The following soils may be listed in this category:

Agassiz loamy sand
Agassiz loamy sand, till substrate phase
Agassiz loamy sand, sand substrate phase
Keld association
Leary loamy sand
Leary loamy sand, till substrate phase
Leary loamy sand, sand substrate phase
Marringhurst association
Seech association

Class VI—Land suitable for hay, grazing or tree production with limitations. These limitations arise from the soils being infertile and either very poorly drained and inaccessible during part of the summer season or very droughty due to coarse texture and steeply sloping topography. The following soils may be listed in this category:

Zaporoza association
Half-Bog

Class VII — Land suited for grazing or forestry with major limitations. The land in this class requires extreme care to prevent erosion, destructive burning, or overgrazing. Such land is steeply sloping and highly susceptible to erosion. Generally this class is most suited for forestry. The following soils may be listed in this category:

Eroded Slopes complex

Class VIII—Land suited only for wild life and recreation. This land may be extremely rough, rocky, or water-logged. The following soils may be listed in this category:

Bog

Part IV.

A. HISTORY OF SETTLEMENT

The pioneer agricultural settlement of the area comprising the West-Lake map sheet progressed in many diverse stages, each representing an important episode in the colonization of Manitoba. People of many nationalities took up land in different portions of the area and this early segregation of ethnic groups still persists.

In 1872, Adam McKenzie followed the "North Trail" beyond the western boundary of early Manitoba to the Arden ridge and established the first farm in the area*. He was shortly followed by several other settlers and the area soon became known as Beautiful Plains. This area, bounded on the north by Kelwood, the west by Franklin, the east by Keyes and extending south to Oberon and Brookdale, became the County of Beautiful Plains when the Province of Manitoba was extended in 1881. By 1883, when the railway reached Neepawa, the population of this county had grown to 1306, consisting mostly of people from Ontario of British ancestry. One group of settlers from southeastern Europe started a colony in 1885 in a valley north-west of Neepawa that soon was named "Hungarian Valley" and later shortened to "Huns Valley".

To the north, in the area of Laurier and Ste. Rose, French and Belgium settlers started arriving in 1891, some coming from Quebec and others from Europe. The Municipality of Ste. Rose was established in 1893. The land between this French settlement on the north and the County of Beautiful Plains on the south was settled largely by Ukrainians in the years 1897 and 1898. In his book, "The Ukrainians of Manitoba", Paul Yuzyk reports that there are about 1,100 Ukrainians in the Glenella colony, including the districts of Glenella, Riding Mountain, Kelwood and McCreary. These people also took up homesteads on the south slope of the Riding Mountain, along with a group of Scandinavians in the Erickson district.

The only other early colony of settlers was the Icelandic group who moved into the "Big Point" area on the south-west shore of Lake Manitoba. This colony, started in 1894, became known as the Langruth settlement when more Icelanders arrived with the railway in 1908*. The remainder of the West-Lake map area is low-lying land of poor agricultural value and was unattractive to pioneer settlers. The area surrounding the Big Grass Marsh north of Gladstone was used as ranch land prior to the First World War. Attempted drainage of the marsh and the "Greater Production Campaign" of 1916 to 1921 resulted in increased cultivation, mainly by Soldier Settlers. However, a series of floods, alternating with droughts, and a fall in the price of cereals caused widespread abandonment of this poorly drained, stony and high-lime land. By 1926, most of the settlers in this lowland area had left or were preparing to leave, and those that remained were obtaining only a subsistence income from the sale of dairy products or were operating small ranches†.

This same pattern of settlement and early abandonment has re-occurred in more recent years in the Lowland Plain of the West-Lake map area. All attempts at grain farming in this district have failed and only ranching and mixed farming with the main emphasis on livestock production have managed to persist. Future attempts at more productive utilization of this land should benefit from this distressing history.

B. AREA AND PRESENT USE OF FARM LAND

The area and present use of farm land in the West-Lake map area are indicated in the figures contained in the Census of Canada and in Provincial Municipal Records.

The area and disposition of land in each municipality is presented in Table 8. The

*" The Story of Beautiful Plains," by Irene L. Richards, Papers of the Historical and Scientific Society of Manitoba, Series III, Number 8.

*"The Icelanders in Manitoba," by Wilhelm Kristjanson, Public Archives of Manitoba, Unpublished Manuscript.

†"Unused Lands of Manitoba," by R. W. Murchie and H. C. Grant, Manitoba Department of Agriculture and Immigration, 1926.

percentage of cultivated land and improved pasture, as compared to woodland and wasteland, in each municipality is related to the soil types and physiographic land features. Over sixty percent of the land in the municipalities of Minto, Rosedale and Westbourne is cultivated or improved pasture land. These municipalities are located on relatively fertile soils which were easily cleared and broken. Less than thirty percent of the land is cultivated in the municipalities of McCreary, Glenella, Lakeview and the local Government District of Alonsa. The woodland and wasteland in these municipalities may consist of: stony, gravelly, coarse-textured, swampy or alkali soils; wet depressions; unbroken bush land; ravines and runways. These lands may be utilized to some extent as pasture and woodlots. Some native hay is obtained from the poorly drained or meadow sites.

TABLE 8

Land-Use by Municipalities in West-Lake Map Area
Canada Census Data for 1951

Municipality	Acreage Municipality	Cultivated Land and Improved Pasture (Acres)	Cultivated Land and Improved Pasture (%)	Woodland and Wasteland (Acres)	Woodland and Wasteland (%)
Clanwilliam	82,877	29,255	35.3	53,622	64.6
Minto	92,160	58,189	63.1	33,971	36.9
Park (*L.G.D.)	116,618	44,039	37.7	72,579	62.3
Rosedale	172,800	113,391	65.6	59,409	34.4
Lansdowne	184,320	93,328	50.6	90,992	49.4
Ochre River	117,420	40,018	34.2	77,402	65.8
Ste. Rose	149,535	69,685	46.6	79,850	53.4
McCreary	230,000	59,365	25.8	170,635	74.2
Glenella	215,079	57,361	26.7	157,718	73.3
Westbourne	305,911	210,323	68.7	95,588	31.3
Lakeview	149,435	40,622	27.2	108,813	72.8
Alonsa (*L.G.D.)	951,449	205,930	21.6	745,519	78.4

*L.G.D.—Local Government District.

The type of agriculture followed in the West-Lake area is indicated by the size of farms, the disposition of the land held as farms, and the number of livestock on farms.

(i) *Size of Farms*

The average size of farms in each municipality in the West-Lake area is as follows:

Clanwilliam.....287 acres
Minto.....350 acres
Park I.....312 acres
Rosedale.....303 acres
Lansdowne.....400 acres
Ochre River.....326 acres
Ste. Rose.....395 acres
McCreary.....290 acres
Glenella.....386 acres
Westbourne.....452 acres
Lakeview.....605 acres
Alonsa.....375 acres

(ii) *Disposition of Farmland*

The percentage of the land in each municipality devoted to each of several land-uses is presented in Table 9. There is some variation in cropping from year to year due to viscissitudes of climate and economic conditions. Therefore the 1951 data do not present an

accurate account of land-use today, but the basic pattern can be expected to be similar.

The general cropping practice on cultivated land in the municipalities of the West-Lake area appears to be summerfallow followed by two to three years of grain crops. In the municipalities of Minto, Rosedale, Lansdowne, Glenella and Westbourne over 50 percent of the farmland is devoted to grain crops and flax, wheat, oats and barley constitute the bulk of the seeded acreage. A considerable acreage of the land in the municipalities of Glenella, Ste. Rose, Lansdowne and Westbourne were utilized for flaxseed. This is partly due to forced late seeding caused by widespread imperfect and poor drainage in these municipalities.

In the municipalities of Clanwilliam, Ochre River, Lakeview and the Local Government Districts of Park and Alonsa over 50 percent of the land in farms is woodland and wasteland. This land is utilized for hay and grazing and to a limited extent as farm woodlots. In the municipalities which occur in the Manitoba Lowlands some of the farm holdings are devoted almost exclusively to ranching. The large continuous stretches of nonarable land in the Lowland area are adaptable to this form of land-use.

TABLE 9

Utilization of Land on Farms, West-Lake Map Area
Data for Each Type of Land-Use Given as Percent of Acreage Held as Farms
Canada Census Data 1951

Munucipality	Acreage in Farms	Fallow	Wheat	Other Grains	Flax Seed	Fodder Crops	Root Crops	Improved Pasture	Farm-steads, etc.	Woodland and Wasteland
Clanwilliam.....	69,082	12.3	4.9	17.5	.1	2.7	.04	1.3	3.4	57.8
Minto.....	89,612	18.9	18.1	22.0	1.2	1.7	.03	1.3	1.7	35.1
Park (*L.G.D.).....	104,639	13.2	6.9	17.3	.1	.8	.1	1.6	2.2	57.8
Rosedale.....	163,571	19.5	20.1	19.3	2.9	1.9	.04	3.4	2.2	30.7
Lansdowne.....	158,863	15.0	7.0	21.9	6.8	2.1	.03	3.4	2.5	41.3
Ochre River.....	92,567	8.3	6.8	14.7	3.1	4.7	.02	3.7	1.9	56.8
Ste. Rose.....	107,527	12.2	7.1	20.2	7.0	5.5	.03	10.4	2.3	35.3
McCreary.....	107,638	12.7	8.1	22.7	3.8	2.5	.1	3.3	1.9	44.9
Glenella.....	100,616	14.3	5.2	20.5	11.4	1.9	.04	1.6	1.9	43.0
Westbourne.....	293,804	13.7	6.9	31.8	7.2	2.8	.03	6.9	2.2	28.5
Lakeview.....	105,843	6.5	5.1	18.1	4.4	1.4	.03	1.6	1.2	61.7
Alonsa (L.G.D.).....	218,363	3.1	1.4	6.0	2.8	0.7	.04	3.3	1.5	81.2

*L.G.D.—Local Government District.

(iii) *Number of Livestock*

The average number of horses, cattle, sheep, swine and poultry per section of farmland in each municipality according to the 1951 census is given in Table 10.

There is a general distribution of beef cattle throughout the West-Lake municipalities. A relatively high concentration of dairy cattle is found in the municipality of Minto, while few dairy cattle are kept on farms in the muni-

cipality of Lakeview and the Local Government District of Alonsa. Swine are fairly well distributed throughout the area although few are kept on the average farm in the Municipality of Lakeview and in the Local Government district of Alonsa.

TABLE 10

Number of Horses, Cattle, Sheep, Swine and Poultry by Municipalities in West-Lake Map Area, Expressed as Average Numbers Per Section of Farmland (640 Acres) Canada Census Data 1951

Municipality	Horses	Cattle		Sheep	Swine	Poultry	
		Milk Cows	Other Cattle			Hens and Pullets	Other Poultry
Clanwilliam	6.0	11.6	14.1	1.9	7.9	38	69
Minto	4.0	17.8	11.4	1.3	6.9	35	67
Park (*L.G.D.)	7.5	12.1	10.7	.8	7.9	47	118
Rosedale	4.7	9.8	10.6	1.5	14.0	55	127
Lansdowne	4.1	8.1	13.1	.8	11.9	41	98
Ochre River	4.6	10.0	10.3	4.3	8.8	57	98
Ste. Rose	3.1	6.4	14.1	1.3	5.9	54	95
McCreary	3.0	5.8	6.3	1.6	7.6	35	60
Glenella	2.2	5.3	6.0	1.2	4.6	23	59
Westbourne	2.7	5.5	6.0	.8	7.9	31	72
Lakeview	1.9	2.2	13.6	.9	2.6	19	32
Alonsa (*L.G.D.)	1.6	1.4	9.0	2.1	.9	5	10

*L.G.D.—Local Government District.

(iv) *Crop Yields*

Crop yield figures for Manitoba Crop Reporting District No. 9 (Neepawa) are presented in Table 11. This crop reporting district does not encompass the complete map area, but it is representative of a large portion of the area. During the 31 years for which data are presented, the average yields of wheat and other crops show wide fluctuations. These fluctuations are due to the effect of drought, excessive spring moisture, local flooding, rust and other plant diseases, grasshoppers, etc The reducing effect of such hazards must be taken into consideration in estimating the productive capacity of the area. Unfortunately, no figures are available for a comparison of crop yields on the respective soil types, but higher average yields than those presented in Table 11 can be expected on the better soils and lower average yields can be expected on the poorer soils.

C. GENERAL OBSERVATIONS

Many of the economic and soil problems encountered in the West-Lake map area can be attributed to improper land-use. Only a small portion of the area is suited to the type of grain farming that has been prevalent throughout most of the map sheet. This is evident from the many soil conservation and economic problems that have arisen in this district. Clearing and cultivation of steeply sloping land on the southern portion of the Riding Mountain has resulted in severe water erosion on the slopes and increased flooding of good agricultural land on the level plain. Many drainage ditches constructed in the Lowland Plain to improve the value of that area are rendered ineffectual by deposition of sediments carried in by runoff water from the cleared slopes of the mountain. An over-all program of soil conservation and water control is sorely needed in this area.

TABLE 11

Average Yields of Field Crops in Manitoba Crop Reporting District No. 9 (Neepawa) 1926 to 1956

Year	Wheats	Oats	Barley	Fall Rye	Spring Rye	Flax	Potatoes
1926	18.5	21.4	31.4	16.4	13.0	9.4	140
1927	10.8	14.2	20.0	16.5	11.4	10.1	155
1928	20.5	35.6	28.4	17.0	13.2	10.2	181
1929	12.4	14.1	13.7	14.0	8.7	6.3	53
1930	16.8	29.6	23.4	16.4	11.1	9.0	120
1931	11.5	16.1	14.9	13.1	8.9	4.8	122
1932	16.8	28.0	22.4	17.8	10.5	5.6	121
1933	18.7	24.8	18.8	13.9	11.8	7.0	147
1934	18.0	16.5	11.9	11.4	10.0	6.1	75
1935	5.8	19.6	19.5	14.1	12.1	8.3	128
1936	13.9	16.5	15.8	11.7	10.0	5.3	63
1937	18.8	36.5	27.7	17.1	12.4	9.1	145
1938	17.4	28.4	22.4	15.7	10.8	8.1	51
1939	23.3	26.7	21.9	15.1	11.0	6.5	61
1940	22.1	28.5	22.6	14.5	14.8	8.7	77
1941	22.4	30.0	27.4	19.1	18.7	8.7	101
1942	27.3	45.0	35.0	19.0	20.0	10.0	85
1943	25.0	39.0	32.2	13.5	15.0	10.0	95
1944	25.0	40.0	30.0	15.0	16.0	11.0	80
1945	23.3	32.7	26.7	18.0	—	11.0	80
1946	24.0	37.0	26.0	14.7	—	10.0	60
1947	21.0	29.4	22.8	18.0	—	9.5	76
1948	26.8	41.7	31.9	18.3	14.9	9.7	61
1949	18.6	20.3	32.6	25.0	15.0	7.3	70
1950	21.5	45.0	30.0	14.0	—	9.0	82
1951	22.1	33.5	27.0	18.3	15.8	7.5	166
1952	27.1	41.4	35.0	17.5	15.9	9.9	151
1953	25.7	39.8	25.9	18.0	15.0	9.1	160
1954	14.1	26.4	22.0	14.0*	—	9.0	117
1955	23.0	35.9	21.4	19.3*	—	8.1	140
1956	25.5	45.0	22.1	18.2*	—	8.9	160
Average Yield	19.9	30.3	24.6	16.3	13.2	8.5	107

*Includes Fall and Spring Rye, but the rye crop was almost entirely Fall Rye.

The depressing history of recurring land settlement and abandonment in the low-lying eastern portion of the West-Lake area is tragic evidence of improper land-use. The extensive areas of shallow, stony Isafold and Garson soils and poorly drained Lakeland, Half Bog and Bog soils are not suited to grain production. All attempts at such utilization have failed. The cultivated soils are subject to flooding in wet seasons and to lime induced physiological drought in dry seasons. The consistently poor yields are small reward for the years of hard

labor necessary to clear the land of bush and stones prior to cultivation. Livestock are essential to the utilization of this area. Some ranching has been conducted successfully in portions of the area where open grassland provides economical pasture. But ranching cannot support the cost of clearing and seeding necessary to convert the bushland into productive pasture. Some forms of livestock farming and dairying appear to provide the best ultimate use of this land.

Appendix

CHEMICAL AND PHYSICAL ANALYSES

Chemical and physical analyses of surface soils and soil profiles are presented in Tables 12, 13 and 14.

The samples for profile analyses were obtained from representative virgin sites. Where possible, the surface samples were obtained in pairs from virgin sites and adjacent cultivated fields.

The soil textural classes as utilized in the report and in the Tables are based on a modified chart of Davis and Bennett, U.S.D.A. Circular 39 as published in "The Soils of Manitoba" by J. H. Ellis, Economic Survey Board, Province of Manitoba.

The physical and chemical methods of analysis used are as follows:

MECHANICAL ANALYSIS—The pipette method was used as described by Kilmer and Alexander with minor variations. Kilmer, V. J. and L. T. Alexander. Methods of making mechanical analysis of soils. Soil Science 68:15-24. 1949.

MOISTURE EQUIVALENT—Briggs and McLane method. Briggs, L. J. and J. W. McLane. The moisture equivalent of soils. U.S.D.A. Bur. Soils Bul. 45:1-23. 1907.

ORGANIC AND INORGANIC CARBON—A modification of the methods of Adams and Waynick was used. Adams, J. E. Determination of total carbon in soils by the wet combustion method. J. of Ind. and Eng. Chem. Anal. Ed., 6:227. 1934. Waynick, D. D. A simplified wet combustion method for the determination of carbon in soils. J. Ind. and Eng. Chem. 11:634. 1919.

NITROGEN—The Kjeldahl-Gunning Arnold method was followed. A.O.A.C. 5th Ed. 1940.

pH VALUES—pH was determined on soil paste with a Coleman glass electrode apparatus.

TABLE 12

Analyses of Representative Soil Profiles

Depth (In Inches)	Horizon Designation	Moisture Equivalent	Organic Carbon	Nitrogen	C/N Ratio	Percent CO_3	Reaction (pH)
NEWDALE CLAY LOAM, WELL-DRAINED ASSOCIATE							
0 - 8	A	29.6	4.04	.25	16.2	.9	7.5
8 - 11	AB	24.0	1.95	.19	10.1	7.2	7.7
11 - 19	C_{ca}	26.8	.72	.07	10.8	19.8	7.9
19 - 30	C_1	22.6	.38	.04	9.7	14.7	7.9
30+	C_2	24.1	.81	.04	—	12.1	7.9
TOBARMORE FINE SANDY CLAY LOAM, WELL-DRAINED ASSOCIATE							
0 - 6	A_1	26.5	1.99	.15	13.5	0.0	6.6
6 - 12	AB	25.9	.32	.05	6.7	.4	7.0
12 - 22	B_2	25.5	.42	.07	6.3	.7	7.3
22 - 30	C_1	22.2	.47	.05	9.8	8.2	7.5
30 - 40	C_2	19.9	.32	.03	11.4	6.9	7.4
40 - 50	C_2	13.4	.46	.03	—	7.8	7.7
STOCKTON LOAMY FINE SAND, WELL-DRAINED ASSOCIATE							
0 - 9	A	5.8	1.12	.10	11.3	0.0	7.6
9 - 20	B	4.0	.28	.03	8.8	0.0	7.7
20 - 30	C_1	2.0	.59	.06	10.7	4.7	8.1
30+	C_2	2.0	.24	.02	10.0	3.5	8.3
ARDEN CLAY LOAM, IMPERFECTLY DRAINED ASSOCIATE							
0 - 11	A	30.0	5.26	.46	11.4	4.5	7.6
11 - 16	C_{ca}	21.0	.97	.11	9.1	26.6	7.8
16 - 26	C_1	21.6	.45	.05	9.4	24.9	7.8
26+	C_2	22.7	.41	.04	11.4	22.2	7.9
NORGATE CLAY, IMPERFECTLY DRAINED ASSOCIATE							
0 - 6	A	42.1	3.67	.38	9.7	1.4	7.4
6 - 12	C_{ca}	28.2	1.01	.11	9.4	13.1	7.8
12 - 24	C_1	25.3	.55	.04	12.8	9.4	7.6
24 - 36	C_2	27.4	.39	.03	14.0	7.4	7.6
DAUPHIN CLAY, POORLY DRAINED ASSOCIATE							
0 - 14	A	63.2	6.68	.63	10.6	1.0	7.6
14 - 19	C_{ca}	43.8	1.05	.15	6.9	16.2	7.6
19+	C	47.6	.73	.12	6.1	6.1	7.5

TABLE 12—(Continued)

Analyses of Representative Soil Profiles

Depth (In Inches)	Horizon Designation	Moisture Equivalent	Organic Carbon	Nitrogen	C/N Ratio	Percent CO_3	Reaction (pH)
LAKELAND CLAY LOAM, IMPERFECTLY DRAINED ASSOCIATE							
0 - 5	A	30.5	4.18	.04	10.7	8.9	7.9
5 - 11	C_1	20.2	.61	.04	15.6	32.6	8.5
11+	C_2	17.0	.29	.02	18.1	32.1	8.3
ALMASIPPI FINE SANDY LOAM, IMPERFECTLY DRAINED, CALCAREOUS ASSOCIATE							
0 - 10	A	24.1	2.60	.19	13.4	10.9	8.3
10 - 18	C_{11}	14.1	.74	.07	11.0	12.6	8.3
18 - 26	C_{12}	7.1	.11	.02	5.8	7.9	8.4
26+	C_2	10.9	.19	.02	11.9	13.6	8.1
ALMASIPPI LOAMY FINE SAND, IMPERFECTLY DRAINED ASSOCIATE							
0 - 10	A	4.7	.61	.05	12.7	0.0	7.9
10 - 16	B	3.1	.19	.04	4.3	0.0	7.9
16 - 30	C_1	3.6	.01	.03	—	0.0	7.7
30 - 48	C_2	4.1	.20	.02	10.5	5.2	8.0
WESTBOURNE CLAY, POORLY DRAINED, SALINE ASSOCIATE							
0 - 8	A	43.7	4.75	.48	9.8	13.1	8.1
8 - 13	C_1	32.6	.49	.14	3.6	14.9	8.1
13+	C_2	26.9	.01	.03	—	23.9	8.1
ONANOLE CLAY LOAM, MODERATELY WELL-DRAINED ASSOCIATE							
0 - 8	A	23.4	4.28	.29	14.6	.5	7.1
8 - 11	AB	19.2	.97	.08	12.3	.3	7.2
11 - 17	B_2	17.4	.47	.04	12.1	.1	7.2
17 - 20	B_3	17.8	.49	.07	6.9	11.5	7.6
20 - 30	C_1	17.2	.31	.06	5.5	12.7	7.7
30 - 40	C_2	19.6	.20	.03	6.3	12.8	7.7
40 - 50	C_2	15.3	.08	.02	5.0	11.7	7.6
50 - 60	C_2	24.1	.10	.02	4.2	14.2	7.7
ERICKSON CLAY LOAM, WELL-DRAINED ASSOCIATE							
0 - 3	A_1	28.5	4.56	.37	12.2	0.0	6.4
3 - 5	A_2	23.8	2.01	.18	11.5	0.0	6.2
5 - 11	B_2	24.9	.53	.05	11.0	.5	6.5
11 - 16	B_3	22.6	.61	.05	12.7	10.5	7.6
16 - 26	C_1	22.6	.47	.06	8.6	12.2	7.7
26 - 36	C_2	25.1	.44	.03	13.8	12.4	7.9
36 - 48	C_2	22.5	.38	.07	5.4	12.1	7.8
48 - 60	C_2	22.8	.33	.05	6.9	11.7	7.7

TABLE 12—(Continued)

Analyses of Representative Soil Profiles

Depth (In Inches)	Horizon Designation	Moisture Equivalent	Organic Carbon	Nitrogen	C/N Ratio	Percent CO_3	Reaction (pH)
MEADOWBROOK CLAY, WELL-DRAINED ASSOCIATE							
0 - 2	A_1	42.1	8.18	.68	12.1	.2	6.5
2 - 5	A_2	29.4	1.69	.19	8.9	0.0	6.1
5 - 9	B_1	37.7	.73	.10	7.1	0.0	5.6
9 - 16	B_2	39.0	.85	.10	8.6	.6	6.8
16 - 30	B_3	31.3	.25	.05	4.8	10.9	7.6
30 - 40	C_1	31.8	.17	.06	2.7	11.5	7.6
40 - 48	C_2	32.4	.63	.05	12.1	12.0	7.7
48 - 60	C_2	33.7	.43	.04	9.8	11.2	7.8
BIRNIE CLAY LOAM, WELL-DRAINED ASSOCIATE							
0 - 8	A	21.4	2.78	.33	8.4	.3	7.5
8 - 11	AB	25.0	1.53	.18	8.5	0.0	7.3
11 - 18	B	24.1	.76	.14	5.4	5.0	7.4
18 - 29	C_1	26.8	.26	.09	2.9	15.9	7.3
29 - 40	C_2	29.9	.25	.06	4.2	15.6	7.5
40+	C_2	25.1	.18	.05	3.6	11.9	7.4
SELINA LOAMY FINE SAND, IMPERFECTLY DRAINED ASSOCIATE							
0 - 2	O	164.4	22.15	1.38	16.1	.5	6.1
2 - 8	A_1	4.1	1.09	.04	—	0.0	5.7
8 - 15	B	4.3	.35	.01	—	0.0	5.8
15 - 25	C_1	1.6	.21	.01	—	1.4	7.9
25+	C_2	2.1	.34	.00	—	3.3	7.8
WAITVILLE CLAY LOAM, WELL-DRAINED ASSOCIATE							
0 - 2	O	108.7	30.20	1.76	17.2	.6	6.2
2 - 7	A_2	12.9	.57	.08	7.1	0.0	6.1
7 - 11	B_1	22.8	.63	.09	7.0	0.0	6.0
11 - 15	B_2	24.8	.61	.09	6.8	.3	6.4
15 - 21	B_3	20.9	.45	.07	6.4	6.5	7.3
21 - 32	Cca	22.6	.39	.06	6.5	18.3	7.7
32 - 48	C	23.3	.41	.05	8.2	14.8	7.7
GRANVILLE CLAY LOAM, WELL-DRAINED ASSOCIATE							
0 - 2	O	95.3	24.56	1.68	14.6	0.0	5.4
2 - 5	A_2	18.5	1.08	.14	7.7	0.0	4.9
5 - 11	A_3	27.1	.94	.07	13.4	0.0	4.5
11 - 14	B_1	27.5	.48	.06	8.0	0.0	5.0
14 - 20	B_2	29.0	.40	.06	6.7	0.0	4.9
20 - 26	B_{31}	25.4	.25	.08	3.1	6.6	7.0
26 - 36	B_{32}	22.9	.34	.05	6.8	10.0	7.3
36 - 48	C_1	22.9	.18	.05	3.6	12.9	7.4

TABLE 12—(Continued)

Analyses of Representative Soil Profiles

Depth (In Inches)	Horizon Designation	Moisture Equivalent	Organic Carbon	Nitrogen	C/N Ratio	Percent CO_3	Reaction (pH)
GRANVILLE CLAY LOAM, WELL-DRAINED ASSOCIATE—Continued							
48 - 60	C_1	22.7	.21	.05	4.2	12.8	7.4
60 - 72	C_1	22.9	.23	.05	4.6	13.2	7.5
72 - 84	C_2	22.8	.10	.04	2.5	12.7	7.4
84+	C_2	23.1	.25	.05	5.0	11.8	7.4
CLARKSVILLE HEAVY CLAY LOAM, WELL-DRAINED ASSOCIATE							
0 - 1	O	119.1	32.66	1.91	17.1	0.0	5.9
1 - 6	A_{21}	28.6	1.74	.16	10.9	0.0	5.4
6 - 12	A_{22}	28.4	.87	.10	8.7	0.0	5.5
12 - 16	A_3	30.7	.61	.12	5.1	0.0	5.3
16 - 20	B_1	34.2	.55	.06	9.2	0.0	5.1
20 - 25	B_{21}	35.5	.48	.09	5.3	0.0	5.5
25 - 30	B_{22}	34.1	.46	.08	5.5	.9	6.1
30 - 38	B_{31}	33.2	.48	.09	5.3	1.4	6.4
38 - 48	B_{32}	31.7	.50	.09	5.6	3.8	6.9
48 - 60	C_1	29.4	.36	.07	5.1	8.8	7.2
60 - 72	C_1	30.5	.32	.06	5.3	11.3	7.4
72 - 84	C_1	29.7	.38	.05	7.6	8.7	7.4
84+	C_2	31.1	.32	.04	8.0	9.2	7.1
ISAFOLD LOAM, IMPERFECTLY DRAINED ASSOCIATE							
0 - 6	A	42.2	7.14	.60	11.9	2.4	7.6
6 - 12	C_1	26.3	.77	.09	8.5	29.8	8.0
12 - 24	C_2	13.7	.01	.02	—	35.0	8.4
24+	C_2	11.4	.13	.01	—	34.4	8.4
EDWARDS SILTY CLAY, IMPERFECTLY DRAINED ASSOCIATE							
0 - 24	C	62.1	2.25	.23	10.0	.5	7.6
24 - 48	C	55.2	1.15	.12	9.4	.1	7.3
48 - 72	C	55.6	.99	.10	10.0	.3	7.3
72 - 96	C	57.9	1.37	.13	10.8	.6	7.4
GLADSTONE SILTY CLAY LOAM, SEMI-MATURE PHASE							
0 - 12	A	29.0	1.77	.17	10.6	19.7	8.2
12 - 24	C	28.6	1.57	.16	10.1	19.7	8.2
24 - 36	C	32.6	2.04	.20	10.3	20.6	8.0
36 - 48	C	30.4	1.53	.15	10.4	17.9	8.0
48 - 60	C	28.4	.71	.11	6.6	17.9	7.9

TABLE 13

Mechanical Analyses of Representative Cultivated Surface Soil Samples From the West-Lake Map Area

SOIL TYPE	SAND				SILT .05 to .002 mm.	CLAY Less than .002 mm.
	Coarse Sand 2.0 to 0.5 mm.	Medium Sand 0.5 to .25 mm.	Fine Sand .25 to .1 mm.	Very Fine Sand .1 to .05 mm.		
Newdale clay loam	6.7	7.6	12.6	8.3	41.1	23.7
Stockton very fine sand	7.6	24.7	14.0	43.6	5.2	4.9
Arden clay loam	4.8	7.5	16.9	12.1	38.3	20.4
Norgate clay	5.0	3.3	6.7	5.8	28.7	50.5
Dauphin clay	1.7	1.7	4.6	3.1	30.7	58.2
Lakeland fine sandy loam	14.7	14.7	22.2	7.5	24.5	16.4
Almasippi very fine sand	0.8	0.8	37.8	48.6	6.2	5.8
Westbourne heavy clay loam	1.9	4.4	12.6	7.6	38.0	35.5
Erickson heavy clay loam	6.8	6.4	13.4	10.1	28.5	34.8
Meadowbrook clay	0.8	0.8	2.4	4.0	33.7	58.3
Birnie fine sandy loam	8.0	9.4	20.9	14.5	30.0	17.2
Waitville fine sandy clay loam	10.6	9.9	19.4	11.7	28.4	20.0
Granville fine sandy clay loam	4.9	5.5	24.4	19.4	23.1	22.7
Clarksville heavy clay loam	2.0	2.6	6.9	6.9	43.4	38.2
Wapus clay loam	14.4	8.5	7.9	6.7	35.8	26.7
Isafold clay loam	9.0	9.7	13.0	7.3	39.8	21.2
Edwards heavy clay loam	12.3	5.1	6.4	4.1	36.9	35.2
Edwards silty clay, shaly phase	1.0	0.3	0.5	1.0	54.0	43.2

TABLE 14

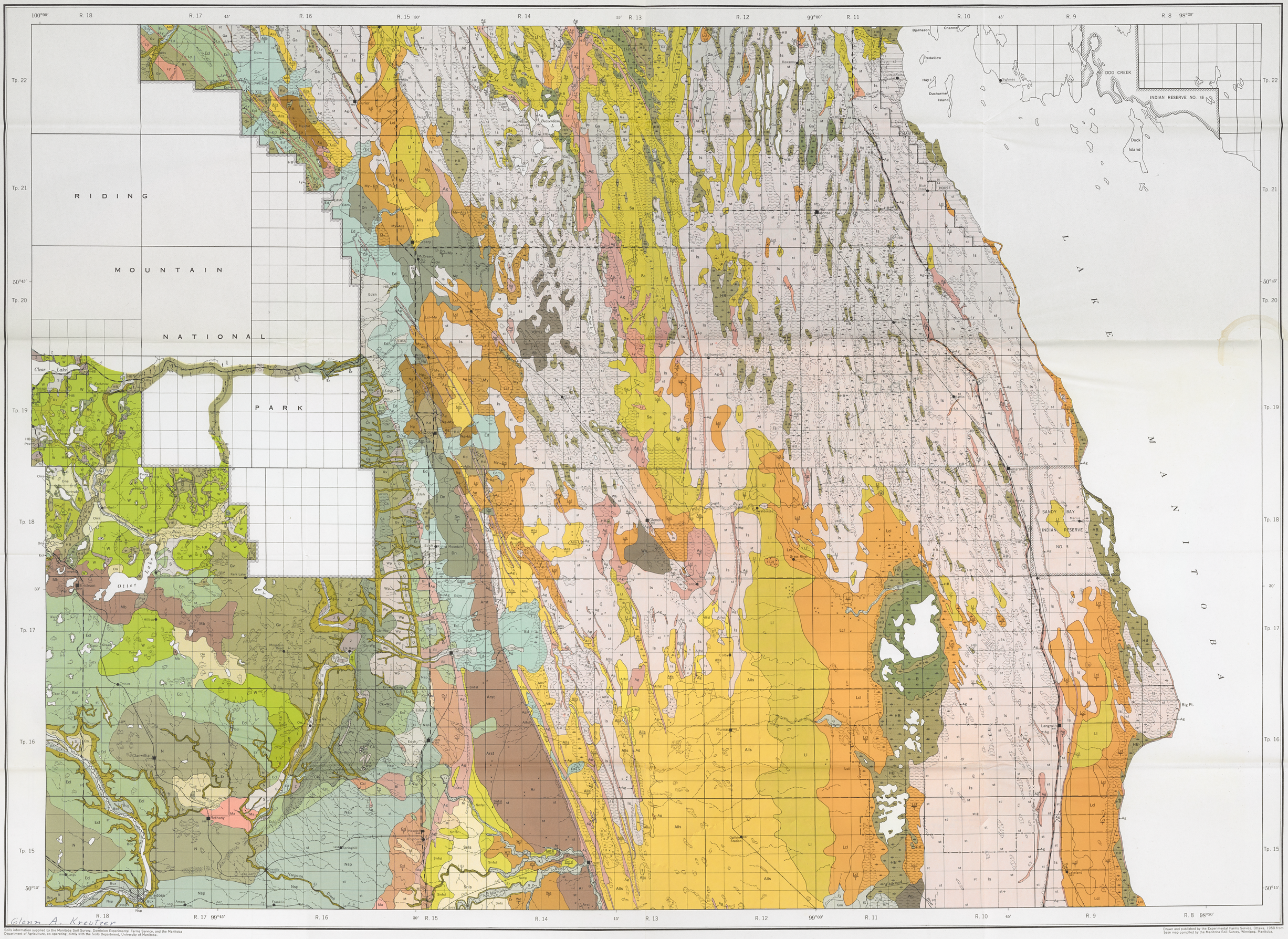
Analyses of Surface Samples From the West-Lake Map Area

Soil Associate	Condition	No. of Samples	Reaction (pH)	Moisture Equivalent	Percent CO_3	Organic Carbon	Nitrogen	C/N Ratio
Newdale, well-drained	Virgin	4	7.1	39.24	.95	7.15	.56	12.77
	Cult.	4	7.3	35.46	1.13	4.88	.39	12.54
Wellwood, well-drained	Virgin	1	5.9	30.51	.11	5.47	.43	12.72
	Cult.	1	7.3	19.39	.00	2.39	.19	12.58
Stockton loamy sand, well-drained	Virgin	1	7.1	6.26	.08	1.40	.11	12.73
	Cult.	1	7.0	5.90	.12	1.25	.10	12.50
Stockton loamy sand, imperfectly drained	Virgin	1	6.5	22.27	.15	5.12	.33	15.51
	Cult.	1	7.6	7.33	.03	1.19	.10	11.90
Stockton fine sandy loam, well-drained	Virgin	1	7.1	31.70	1.33	6.83	.52	13.13
	Cult.	1	7.9	—	.87	2.10	.16	13.12
Arden, well-drained	Virgin	3	7.1	34.44	2.31	6.84	.55	12.38
	Cult.	3	7.5	27.70	3.41	4.15	.33	12.60
Norgate, imperfectly drained	Virgin	2	6.8	45.59	6.84	7.46	.51	15.04
	Cult.	2	7.4	41.95	9.13	5.71	.40	16.45
Dauphin, poorly drained	Virgin	2	6.9	21.86	.18	9.13	.80	12.01
	Cult.	2	7.4	27.97	1.54	4.26	.37	11.25
Lakeland loam, imperfectly drained	Virgin	2	7.5	24.27	8.39	4.38	.38	11.67
	Cult.	2	7.8	27.59	15.05	3.67	.35	10.84
Lakeland clay loam, imperfectly drained	Virgin	3	7.4	36.19	4.34	6.45	.54	11.86
	Cult.	3	7.6	24.14	5.51	3.57	.32	11.09
Almasippi fine sandy loams, imperfectly drained	Virgin	2	7.6	19.03	1.22	4.25	.30	14.40
	Cult.	2	8.0	8.91	.47	1.50	.11	14.53
Westbourne, poorly drained	Virgin	1	7.8	37.63	11.50	4.48	.42	10.67
	Cult.	1	7.7	36.26	10.24	4.50	.41	10.98
Erickson, well-drained	Virgin	1	6.4	31.92	.27	6.46	.59	10.95
	Cult.	1	7.5	23.79	.80	2.43	.23	10.52
Meadowbrook, well-drained	Virgin	3	6.6	35.74	.27	4.37	.36	12.20
	Cult.	3	6.7	34.99	.09	3.29	.18	11.14
Birnie, well-drained	Virgin	4	6.8	40.75	.52	6.26	.43	14.59
	Cult.	4	7.1	33.83	.55	3.25	.25	13.27
Selina, imperfectly drained	Virgin	1	6.8	14.76	2.13	3.19	.22	14.50
	Cult.	1	7.4	9.60	1.65	1.75	.11	15.91
Waitville, well-drained	Virgin	2	5.4	18.12	.02	3.03	.21	14.22
	Cult.	2	6.7	24.15	.26	2.75	.19	14.45
Granville, well-drained	Virgin	3	6.0	23.87	.13	3.11	.24	12.25
	Cult.	3	6.3	20.46	.05	1.63	.16	10.43
Clarksville, well-drained	Virgin	3	6.4	36.63	.14	4.58	.29	17.27
	Cult.	3	6.4	31.55	.16	1.61	.09	10.79
Wapus, well-drained	Virgin	5	5.9	47.94	.18	5.02	.35	14.26
	Cult.	5	6.2	41.85	.11	2.13	.19	11.12
Isafold, imperfectly drained	Virgin	5	7.6	27.56	6.26	5.20	.41	12.86
	Cult.	5	7.8	25.14	10.13	4.38	.30	11.75
Edwards, imperfectly drained	Virgin	3	6.3	61.51	.35	6.26	.49	12.58
	Cult.	3	7.1	59.77	.44	4.54	.36	12.55
Edwards shaly phase, imperfectly drained	Virgin	1	6.3	48.31	.19	6.65	.58	11.46
	Cult.	1	6.8	40.89	.00	4.26	.38	11.21

SOIL MAP
RECONNAISSANCE SURVEY OF WEST - LAKE AREA IN MANITOBA

Scale: 2 miles to 1 inch or 1:126,720

Miles 2 1 0 2 4 6 8 10 Miles



Soils information supplied by the Manitoba Soil Survey, Dominion Experimental Farms Service, and the Manitoba Department of Agriculture, co-operating jointly with the Soils Department, University of Manitoba.

Glenn A. Kreutzer

Drawn and published by the Experimental Farms Service, Ottawa, 1958 from base map compiled by the Manitoba Soil Survey, Winnipeg, Manitoba.

REFERENCE

- Boundary: Soil Association and Phase
- * Soil Associate
- * Indian Reserve
- * Parish and Settlement
- * Forest Reserve
- * Community Pasture
- Township and Range Lines
- Section and Lot Lines
- Trunk Highway
- Secondary Highway
- Railway
- City, Town and Village
- Elevation 2047
- Escarpment
- River and Stream
- Intermittent Stream
- Ditch

KEY TO SYMBOLS

Meadow · Salinized · Marsh and peaty meadow · Spruce swamp · Sharply hilly · Stony and very stony areas

KEY MAP

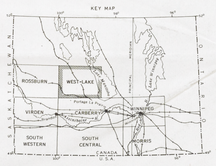


DIAGRAM OF TOWNSHIP

31	32	33	34	35	36	
30	29	28	27	26	25	
19	20	21	22	23	24	
18	17	16	15	14	13	
7	8	9	10	11	12	
6	5	4	3	2	1	

LEGEND

A. SOIL ASSOCIATIONS IN WHICH THE DOMINANT SOIL IS A BLACK

1. DEVELOPED ON BOULDER TILL
   - NEWDALE ASSOCIATION (clay loam)
     - (i) NEWDALE UNDULATING PHASE — N
     - (ii) NEWDALE SMOOTH PHASE — Nsp
2. DEVELOPED ON LACUSTRINE DEPOSITS
   a. Medium textured deposits
   - CARROLL ASSOCIATION
     - (i) CARROLL CLAY LOAM — Ccl
     - (ii) CARROLL CLAY LOAM, TILL SUBSTRATE PHASE — Ccl
   - WELLWOOD ASSOCIATION
     - WELLWOOD LOAM, TILL SUBSTRATE PHASE — Wd
   - TOBARMORE ASSOCIATION
     - (i) TOBARMORE LOAM TO CLAY LOAM — To
     - (ii) TOBARMORE TILL SUBSTRATE PHASE — To
   b. Coarse textured deposits
   - STOCKTON ASSOCIATION
     - (i) STOCKTON LOAMY SAND — Snls
     - (ii) STOCKTON FINE SANDY LOAM — Snfsl
     - (iii) STOCKTON TILL SUBSTRATE PHASE — Snfsl
3. DEVELOPED ON GRAVELLY AND COARSE SANDY DEPOSITS
   a. Deposits of limestone and granitic rock origin
   - AGASSIZ ASSOCIATION
     - (i) AGASSIZ LOAMY SAND — Ag
     - (ii) AGASSIZ TILL SUBSTRATE PHASE — Ag
     - (iii) AGASSIZ SAND SUBSTRATE PHASE — Ag
   b. Deposits of shale, limestone and granitic rock origin
   - MARRINGHURST ASSOCIATION (loamy coarse sand to sandy loam) — Ma
   - MINIOTA ASSOCIATION (loamy sand to fine, sandy loam) — M

B. SOIL ASSOCIATIONS IN WHICH THE DOMINANT SOIL IS A BLACK-MEADOW

1. DEVELOPED ON BOULDER TILL
   a. Water-worked till of limestone and granitic rock origin
   - ARDEN ASSOCIATION
     - (i) ARDEN LOAM — Ar
     - (ii) ARDEN GRAVEL LENS PHASE — Arsl
   b. Till of strongly acid shale and granitic rock origin
   - KELD ASSOCIATION (loam to clay) — K
2. DEVELOPED ON THIN LACUSTRINE DEPOSITS OVER TILL
   a. Medium textured deposits over sandy till
   - McCREARY ASSOCIATION (very fine sandy loam to clay loam) — My
   b. Medium textured deposits over shaly clay till
   - NORGATE ASSOCIATION (clay loam to clay) — Ng
   - KELWOOD ASSOCIATION (very fine sandy loam to clay loam) — Kd
3. DEVELOPED ON LACUSTRINE DEPOSITS
   a. Fine textured deposits
   - DAUPHIN ASSOCIATION
     - (i) DAUPHIN CLAY — Dn
     - (ii) DAUPHIN CLAY, TILL SUBSTRATE PHASE — Dn
   b. Medium textured deposits
   - LAKELAND ASSOCIATION
     - (i) LAKELAND LOAM — Ll
     - (ii) LAKELAND LOAM, TILL SUBSTRATE PHASE — Ll
     - (iii) LAKELAND CLAY LOAM — Lcl
     - (iv) LAKELAND CLAY LOAM, TILL SUBSTRATE PHASE — Lcl
   c. Coarse textured deposits
   - ALMASIPPI ASSOCIATION
     - (i) ALMASIPPI LOAMY FINE SAND — Alls
     - (ii) ALMASIPPI LOAMY FINE SAND, TILL SUBSTRATE PHASE — Alls
     - (iii) ALMASIPPI FINE SANDY LOAM — Alfsl

C. SOIL ASSOCIATIONS IN WHICH THE DOMINANT SOIL IS A CALCAREOUS MEADOW

DEVELOPED ON FINE TEXTURED LACUSTRINE DEPOSITS OVER CLAY TILL
- WESTBOURNE ASSOCIATION (clay) — Wb

D. SOIL ASSOCIATIONS IN WHICH THE DOMINANT SOIL IS A DEGRADING BLACK-MEADOW

DEVELOPED ON MEDIUM TO COARSE TEXTURED LACUSTRINE DEPOSITS
- ONANOLE ASSOCIATION
  - (i) ONANOLE SANDY LOAM — Ons
  - (ii) ONANOLE CLAY LOAM — On
  - (iii) ONANOLE CLAY LOAM, TILL SUBSTRATE PHASE — On

E. SOIL ASSOCIATIONS IN WHICH THE DOMINANT SOIL IS A DARK GREY WOODED

1. DEVELOPED ON BOULDER TILL
   a. Medium textured till of shale, limestone and granitic rock origin
   - ERICKSON ASSOCIATION (loam to clay loam) — Ecl
   b. Medium textured till of dominantly shale origin
   - QUERCUS ASSOCIATION (clay loam) — Q
   c. Fine textured till of dominantly shale origin
   - MEADOWBROOK ASSOCIATION heavy clay loam to clay) — Mb
2. DEVELOPED ON GRAVELLY AND COARSE SANDY DEPOSITS
   a. Deposits of limestone and granitic rock origin
   - LEARY ASSOCIATION
     - (i) LEARY LOAMY SAND — Ly
     - (ii) LEARY TILL SUBSTRATE PHASE — Ly
     - (iii) LEARY SAND SUBSTRATE PHASE — Ly
   b. Deposits of shale, limestone and granitic rock origin
   - SEECH ASSOCIATION (sand to fine sandy loam) — S
   c. Deposits dominantly of shale origin
   - BIRNIE ASSOCIATION (fine sandy loam to clay loam) — Bi

F. SOIL ASSOCIATIONS IN WHICH THE DOMINANT SOIL IS AN IMPERFECTLY DRAINED DARK GREY WOODED

DEVELOPED ON COARSE TEXTURED LACUSTRINE DEPOSITS
- SELINA ASSOCIATION
  - (i) SELINA SAND — Sls
  - (ii) SELINA SAND, TILL SUBSTRATE PHASE — Sl

G. SOIL ASSOCIATIONS IN WHICH THE DOMINANT SOIL IS A GREY WOODED

1. DEVELOPED ON BOULDER TILL
   a. Medium textured till of shale, limestone and granitic rock origin
   - WAITVILLE ASSOCIATION (loam to clay loam) — W
   - GRANVILLE ASSOCIATION (very fine sandy loam to clay loam) — Gr
   b. Medium textured till of dominantly limestone origin
   - GARSON COMPLEX (loamy sand to clay loam) — Gs
   c. Medium textured till of dominantly shale origin
   - CLARKSVILLE ASSOCIATION (very fine sandy loam to clay loam) — Ck
   d. Fine textured till of dominantly shale origin
   - BLACKSTONE ASSOCIATION (clay loam to clay) — Bl
2. DEVELOPED ON THIN SHALY DRIFT DEPOSITS OVER SHALE ROCK
   - WAPUS ASSOCIATION (fine sandy loam to clay loam) — Wp
3. DEVELOPED ON MEDIUM AND COARSE TEXTURED LACUSTRINE DEPOSITS
   - RACKHAM ASSOCIATION
     - (i) RACKHAM SANDY LOAM — Rs
     - (ii) RACKHAM SANDY LOAM, TILL SUBSTRATE PHASE — Rs
     - (iii) RACKHAM CLAY LOAM — R
     - (iv) RACKHAM CLAY LOAM, TILL SUBSTRATE PHASE — R
4. DEVELOPED ON GRAVELLY AND COARSE SANDY DEPOSITS
   - ZAPOROZA ASSOCIATION (coarse sand to sandy loam) — Z

H. SOIL ASSOCIATIONS IN WHICH THE DOMINANT SOIL IS A RENDZINA

DEVELOPED ON HIGHLY CALCAREOUS BOULDER TILL
- ISAFOLD ASSOCIATION (loamy sand to clay loam) — Is

I. ALLUVIAL SOILS

1. DEVELOPED ON SLIGHTLY TO MODERATELY CALCAREOUS DEPOSITS
   - EDWARDS ASSOCIATION
     - (i) EDWARDS SILT LOAM TO SILTY CLAY — Ed
     - (ii) EDWARDS SHALY PHASE — Edsh
     - (iii) EDWARDS SEMI-MATURE PHASE — Edm
     - (iv) EDWARDS SEMI-MATURE, TILL SUBSTRATE PHASE — Edm
2. DEVELOPED ON MODERATELY TO HIGHLY CALCAREOUS DEPOSITS
   - GLADSTONE ASSOCIATION
     - (i) GLADSTONE SILT LOAM TO SILTY CLAY — G
     - (ii) GLADSTONE SEMI-MATURE PHASE — Gm
3. DEVELOPED ON VARIABLE ALLUVIAL DEPOSITS IN THE MINNEDOSA RIVER VALLEY
   - ASSINIBOINE COMPLEX (silty clay loam to clay) — As
4. DEVELOPED ON FINE TEXTURED ALLUVIAL DEPOSITS ON RIDING MOUNTAIN
   - PROVEN LAKE ASSOCIATION (silty clay loam to clay) — Pla

J. ORGANIC SOILS

1. ORGANIC DEPOSITS 12 TO 30 INCHES THICK
   - HALF BOG — HB
2. ORGANIC DEPOSITS OVER 30 INCHES THICK
   - BOG — B

K. UNCLASSIFIED SOILS

1. ERODED CHANNELS AND STEEP SLOPES
   - ERODED SLOPES COMPLEX — Er
2. VARIABLE SOILS ON BENCHLANDS IN RIVER VALLEYS
   - BENCHLANDS COMPLEX — Bck